ON THE COVER

THE stone shaft pictured on the front cover marks the spot at Wrightstown, Pa., a dot on the map, where a large chestnut tree stood more than 200 years ago. At sunrise on September 19, 1737, three men, each with a hand on the tree, set out at a given signal on the infamous "Penn's Walk," or "Walking Purchase," a subterfuge that served to extort thousands of acres of land from the Delaware Indians. The plot was fomented by Thomas Penn, who thereby reversed the traditional policy of his father, William Penn, towards the natives and lost their friendship. Details of the walk and its results are given in our leading article. The shaft was erected in 1890 by the Bucks County Historical Society and dedicated to the memory of the Leni-Lenape (Delaware) Indians. At the left in the picture are two official Pennsylvania roadside markers bearing inscriptions referring to the walk.

•

IN THIS ISSUE

DIMINUTION of the fabulous Lake Superior iron-ore deposits and a change in the basis of billing freight charges on shipments of steel-mill products are the main underlying reasons for an impending influx of steel-producing plants on the Atlantic seaboard. Already firmly entrenched there is Bethlehem Steel Company, which has its largest individual works (5,000,000 ingot tons annual capacity) located at Sparrows Point, Md., in a favorable position for water transportation to bring in foreign ores and ship out finished steel products to the populous seacoast areas. In order to avail itself of ores from Venezuela and, probably later, from Labrador, the United States Steel Company has embarked upon the largest single expansion project in the history of the industry: the $400,000,000 Fairless Works on the Delaware River, near Trenton, N.J. Particulars of the plant and some historic background of the area concerned are given in our leading article. Meanwhile, National Steel Company has acquired ground farther down the river for a large new plant. The additional facilities to be provided by the two concerns will vastly strengthen the nation's capacity for turning out vital steel for the defense program.

•

THE simple idea of using natural air currents to evaporate liquid and thereby create a cooling effect is being successfully applied to air conditioning by a concern in Phoenix, Ariz. The dry, hot air of the Southwest is especially favorable to this type of cooling. Page 93.

•

ONCE considered a bothersome contaminant in lead ores, and charged for accordingly in smelting the latter, zinc no longer causes metallurgists great trouble, thanks primarily to the advent of the selective-flotation milling process. As a result, a mineralized belt in the Coeur d'Alene Mountains of Idaho that was formerly shunned is now coming into its own. Page 96.

Compressed Air Magazine

VOLUME 56 **April, 1951** NUMBER 4

G. W. MORRISON, *Publisher*
C. H. VIVIAN, *Editor* J. W. YOUNG, *Director of Advertising*
ANNA M. HOFFMANN, *Associate Editor* J. J. KATARBA, *Business Mgr.*
A. W. LOOMIS, *Assistant Editor* JOSEPH C. DILTS, *Advertising Mgr.*
D. Y. MARSHALL, *Europe*, 243 Upper Thames St., London, E. C. 4.
F. A. McLEAN, *Canada*, New Birks Building, Montreal, Quebec.

EDITORIAL CONTENTS

ADVERTISING INDEX

A monthly publication devoted to the many fields of endeavor in which compressed air serves useful purposes. Founded in 1896.

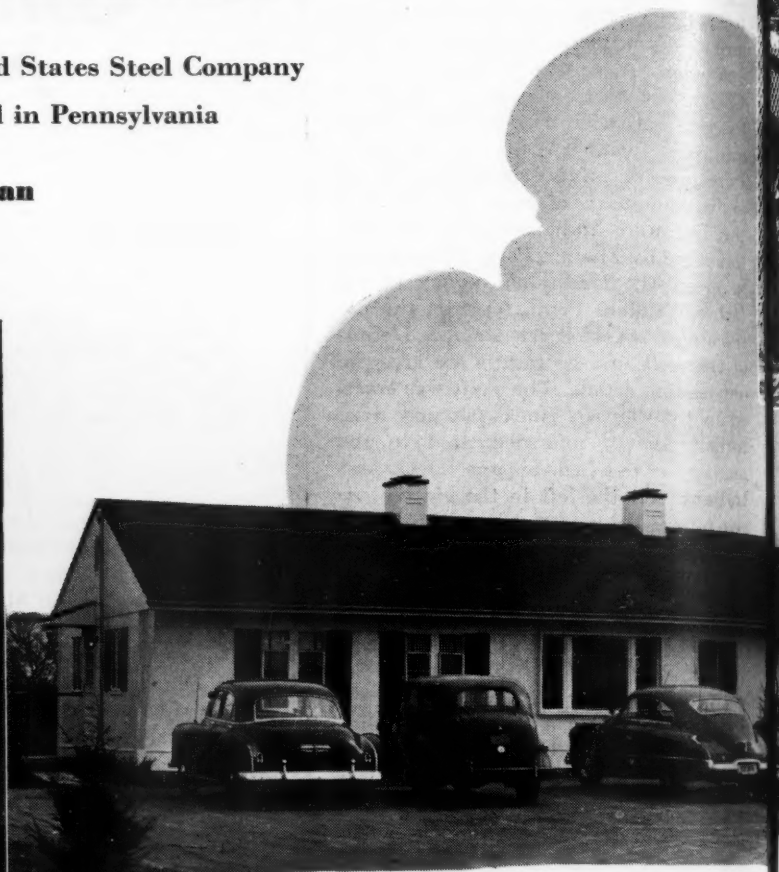
CCA Member Controlled Circulation Audit

Published by Compressed Air Magazine Co., G. W. MORRISON, *President;* C. H. VIVIAN, *Vice-President;* J. W. YOUNG, *Secretary-Treasurer.*
Editorial, advertising, and publication offices, Phillipsburg, N. J.
New York City Office, 11 Broadway. L. H. GEYER, *Representative.*
Annual subscription: U.S., $3.00; foreign, $3.50. Single copies, 35 cents.
COMPRESSED AIR MAGAZINE is on file in many libraries and is indexed in Industrial Arts Index and in Engineering Index.

Steel Mill on the Delaware

Vast New Fairless Works of United States Steel Company to Rise on Historic Ground in Pennsylvania

C. H. Vivian



TURNING EARTH FOR $400,000,000 PROJECT

Benjamin F. Fairless, president of United States Steel Company, shown making a left-handed heave of a stainless-steel shovelful of earth to break ground on March 1 for what will be the largest steel works ever built all at one time. Named in honor of Mr. Fairless, the plant will produce some steel in 1951 and will be operating at full capacity by the end of 1952. Looking on are, left to right: Gov. John S. Fine of Pennsylvania; Irving S. Olds, board chairman of U. S. Steel; and Gov. Alfred E. Driscoll of New Jersey.

NOT far from Morrisville, Pa., across the Delaware River from Trenton, N. J., ground was broken on March 1 for the largest steel mill ever to be constructed all at one time. The $400,000,000 plant is scheduled to go into partial operation six months hence and to reach its full capacity of 1,800,000 ingot tons of steel annually sometime in 1952. It is being built at top speed by the United States Steel Company to help meet the nation's needs for more steel products for the defense program.

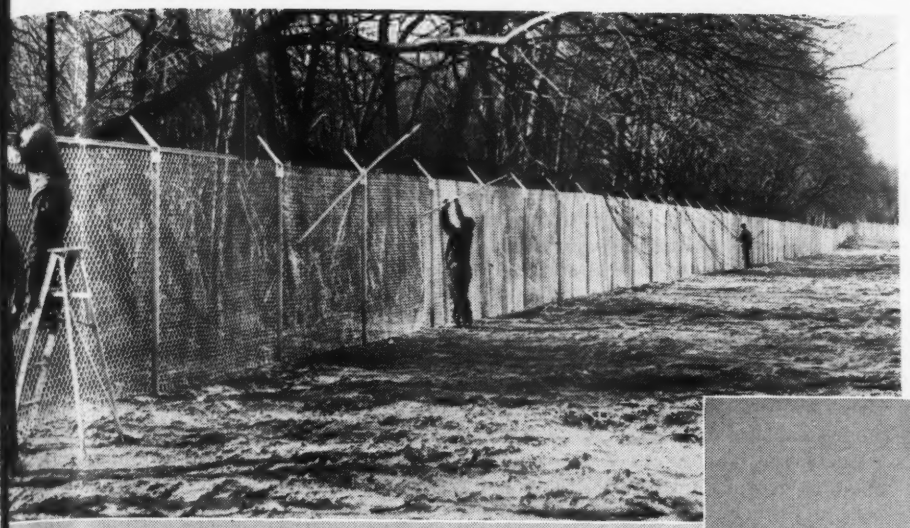
Honoring Benjamin F. Fairless, President of United States Steel Corporation, it will be called the Fairless Works. Mr. Fairless heaved the first four shovelfuls of earth into the scoop of an excavating machine in the presence of some 600 invited guests that included the governors of Pennsylvania and New Jersey, numerous other dignitaries, and officials of some of the country's leading industrial concerns. Because of inclement weather, the ceremonies and the luncheon that preceded them were held under a striped canvas tent large enough to cover two football fields.

The principal facilities of Fairless Works will include two 85-oven by-product coke batteries with an annual capacity of 916,000 tons of coke and large quantities of gas and coal chemical products; two blast furnaces with a yearly output of 1,200,000 tons of pig iron; nine open-hearth furnaces with an annual capacity of 1,800,000 tons of steel; an 80-inch hot-strip mill and auxiliary finishing facilities; equipment for finishing cold-rolled sheets and tin plate; a bloom-slab mill and a billet mill, both with auxiliaries; and a mill for making bars from ⅜ inch to 2 inches in diameter.

All the aforementioned units will be operated by the United States Steel Company, a subsidiary organized by the parent United States Steel Corporation last November to combine under one management the following divisions: Carnegie-Illinois Steel Corporation, United States Steel Corporation of Delaware, H. C. Frick Coke Company, and the United States Coal & Coke Company. In addition, another subsidiary—National Tube Company—will run a mill for the production of butt-weld pipe in sizes from ½ inch to 4 inches and will maintain a warehouse large enough to hold 30,000 tons.

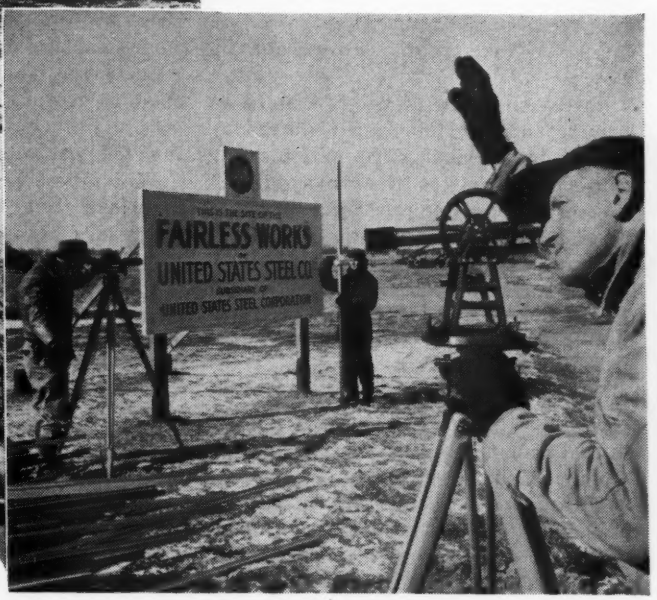
Fairless Works will have an initial annual capacity of 289,000 tons of cold-rolled sheets, 235,000 tons of hot-rolled sheets, 281,000 tons of standard pipe, 285,000 tons of bar products, and 170,000 tons of tin-mill products. Expressed in terms more readily understandable to the layman, this is enough steel to build the following: ten aircraft carriers, 500 airplanes, 500,000 three-inch shells, two heavy cruisers, 500 army tanks, 10,000 freight cars, 300,000 automobiles, and 574,000 household refrigerators.

Supplementing the basic manufacturing facilities will be steam and power



FORERUNNERS OF CONSTRUCTION

Weeks before the formal inauguration of construction, surveyors (below) were swarming over the area and crews began fencing the 3800-acre tract (left).



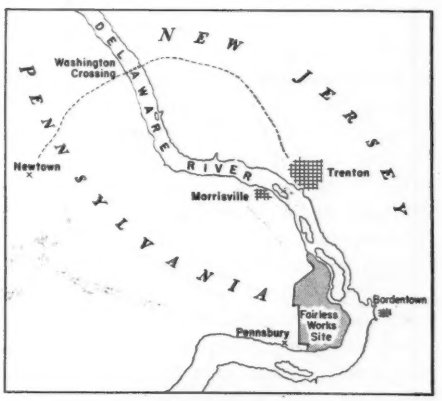
FIRST BUILDING

This small frame structure at the northern end of the tract is temporarily serving many purposes. During the first week of March as many as 3000 persons called there one day to obtain blanks on which to apply for jobs that will not exist until the first units of the plant are started up. Ninety percent of the 4900 workers will be hired locally.

plants, intraplant railways and roads, water-supply and sewerage systems, and materials-handling equipment, including docks to accommodate ocean-going vessels bringing in ore and other raw materials and carrying away finished products. The Delaware River is navigable to Trenton, 5 miles upstream from the plant site, and that was one of the primary reasons for selecting the location. The water has a mean depth ranging from 12 to 25 feet, and the channel will be dredged to the latter depth by the U. S. Army Engineer Corps under a program already authorized. The distance to the open ocean is about 100 miles.

Construction of the new mill is but one step—although the most important one—in an extensive expansion program launched by U. S. Steel. It announced last July that it would augment its annual steel-manufacturing capacity in the Pittsburgh and Chicago districts by 1,660,000 tons by the end of 1951. In September it revealed that facilities in the Birmingham, Ala., district would be enlarged to add 500,000 tons a year to its ingot-producing capacity. Since then it has made public plans to increase the annual steel output of its Geneva, Utah, plant by 160,000 tons and the blast-furnace capacity at Youngstown, Ohio, by 112,000 tons, as well as to install an extrusion mill at the National Tube Company's works in Gary, Ind., for making either high-alloy seamless tubing up to 6½ inches in diameter or various shapes and bars. All these activities will reach their height this year, which marks the fiftieth anniversary of the founding of the U. S. Steel Corporation.

The decision to build the Fairless Works was made more than twelve months ago, but the time for starting construction was not set until the national defense program was speeded up in response to developments in Korea. With the exhaustion of high-grade Mesabi iron ores in sight, the corporation began a search for other sources of supply several years ago and divulged in January, 1950, that it had discovered and would exploit a large deposit of hematite in Venezuela. Obviously, it would be more economical to make steel from this ore at some eastern seaboard location than to transship it to existing inland plants. A seaboard mill would also improve U. S. Steel's competitive position in the vast industrial section bordering the Atlantic coastline.



LOCATION MAP

The steel-mill site lies in a bend of the river about 3½ miles south of Morrisville, Pa., 25 miles from Philadelphia and little more than an hour's train ride from New York City. Nearby is Pennsbury, country home of William Penn, founder of Pennsylvania. Approximately 12 miles upstream is the place where General Washington and his troops crossed the Delaware and surprised the Hessians at Trenton on December 26, 1776. The dotted line indicates the route they followed from their base at Newtown.

Because the corporation already had moderate-sized production facilities in New England, the possibility of enlarging them to create an integrated steel plant was seriously considered. Further study led to the conclusion, however, that the New York-Trenton-Philadelphia area would be a more advantageous location. On December 28, 1949, the Carnegie-Illinois Steel Company announced that it was acquiring a 3800-acre tract in Bucks County, Pa., for possible future use as a steel-mill site. It was added that the erection of such a mill had not been authorized. That was, of course, before trouble broke out in Korea.

As the situation there grew more alarming and the Government moved to meet it by mobilizing the nation's full productive resources, the projected mill took on more importance. On September 29, 1950, it was announced that construction would be advanced, and on December 28 spring of this year was fixed as the starting time and details of the facilities to be provided were made public. Certificates of necessity were issued by the National Security Resources Board to permit U. S. Steel to amortize a substantial proportion of the cost over a 5-year period for tax purposes.

As rapidly as feasible thereafter the company's engineers prepared plans and began awarding contracts for the principal items of equipment required. The more important awards so far announced include the engineering and building of open-hearth furnaces by Koppers Company, Inc., of coke-making facilities by Wilputte Coke Oven Division of Allied Chemical & Dye Corporation, and of blast furnaces by Arthur G. McKee & Company.

The mill site is bordered on the east and south by a wide bend in the Delaware River and is on fertile ground that has for many years been devoted largely to truck gardening. Two large concerns —Starkey Farms Company and King Farms Company—have raised great quantities of broccoli, spinach, beets, stringbeans, asparagus, cabbage, potatoes, and horse-radish and have maintained packing plants and truck fleets to process the vegetables and transport them to markets. All the Starkey property was taken over, but the King holdings fell just outside the tract.

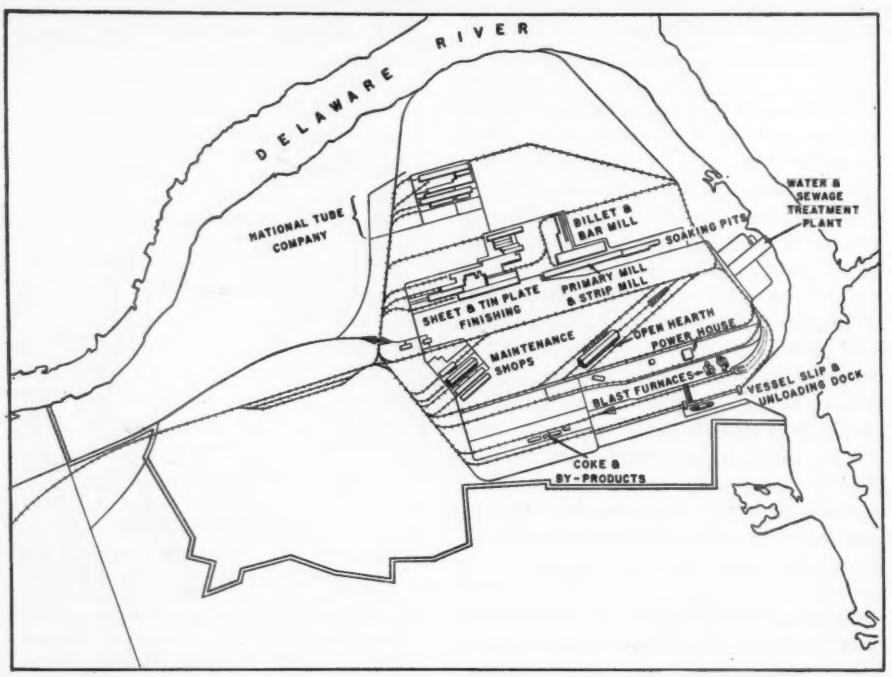
While there has been considerable industrial activity in the surrounding territory for many years, it has not invaded the rather secluded section where the mill will rise. Aside from the farms, the nearest commercial enterprise is a sand-and-gravel business conducted by Warner Company of Philadelphia, Pa. Its pits and processing plants, interspersed with farmlands, lie to the west and south of the tract and are served by the firm's own railway system. A short distance northward of the site is a factory operated by Victor Chemical Company.

The principal industries in Morrisville are the Vulcanized Rubber & Plastics Company and the Robertson Manufacturing Company, which makes building tile. Each concern employs around 500 people. A few miles southward, at Tullytown, Pa., are several establishments, the largest that of Peterson Parchment Company. Across the river in New Jersey, Trenton has numerous industries. Southward and within sight of the steel-mill tract is the main plant of John A. Roebling's Sons Company. It is certain that the Fairless Works will attract many new enterprises. Some concerns, keeping their identities secret for the time being, have already acquired land, and rumors are rife that others are negotiating for sites. Names of several nationally known firms are mentioned in these unconfirmed reports.

The property was assembled for U. S. Steel by the Pennsylvania Railroad. The over-all cost has not been revealed but has been estimated at around $5,000,000. It is a fact, however, that one small piece of ground was paid for at the rate of $75,000 an acre. Possession of some sections was obtained several months ago, but Starkey Farms Company did not relinquish its tenure until March 1 of this year. Meanwhile, work was started on clearing other parts of the tract. Some houses were sold to home-seekers and moved elsewhere. Other structures were razed or even burned, depending upon their condition. A few of the larger ones will be occupied by U. S. Steel or contractors' staffs, at least during the construction period, and one large house may be converted into a clubhouse for steel-company personnel.

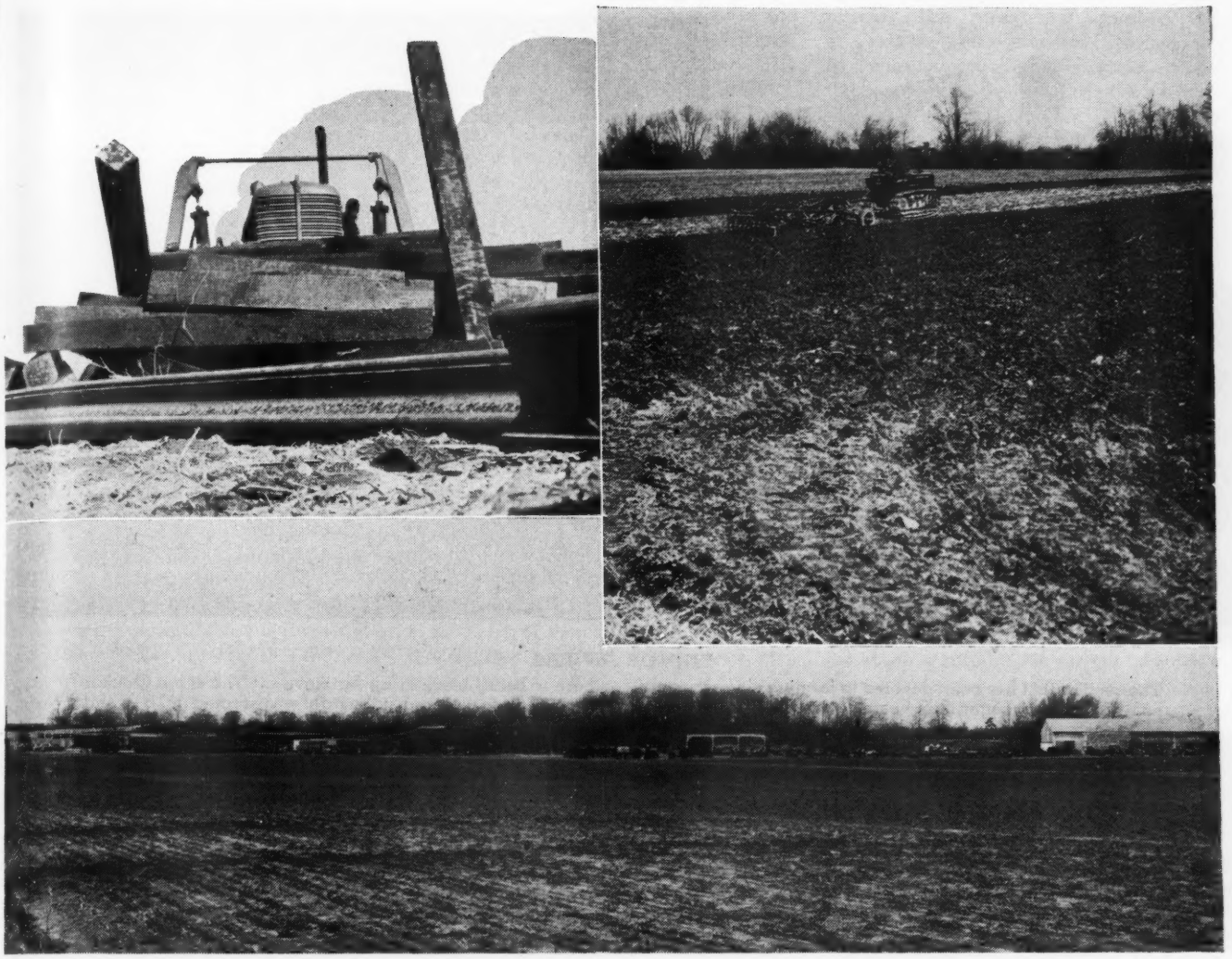
The main New York-Philadelphia line of the Pennsylvania Railroad runs within a mile of the site, and a spur from it was completed shortly before March 1. Over it, special trains from New York and Washington-Philadelphia brought guests for the ground-breaking ceremonies. Shortly afterward it began to make deliveries of heavy earth-moving equipment, and within a few days preparation of the tract began in earnest. Its elevation above sea level varies from 7 to 23 feet. All that area where the mill will rise will be brought to a uniform 20-foot grade, which will involve the movement of around 10,000,000 cubic yards of earth. To accomplish this, some excavations will have to be made, and they are to be used later for blast-furnace slag disposal. Only a small quantity of rock will have to be drilled and blasted. A contract covering this preliminary work, together with the construction of building foundations and floors, roads, railroad tracks, and sewers, has been let to a group headed by the Walsh Construction Company, of Davenport, Iowa, and including S. J. Groves & Sons, Inc., of Minneapolis, Minn.; B. Perini & Sons, Inc., of Framingham, Mass.; and Slattery Construction Company, Inc., of New York City. Operations are in charge of Harry Dugan, project manager.

U. S. Steel has already designated the



LAYOUT OF FAIRLESS WORKS

Except for the mill marked for the National Tube Company, the plant will be operated by the U. S. Steel Company. Double lines indicate the limits of the tract, which includes ample ground at the left for future expansion. A spur from the Pennsylvania Railroad main line, about a mile away, has been built to the site, and the Reading Railway, which has trackage within 5 miles, is seeking government approval to construct a branch line.



PREPARING THE GROUND - TWO STYLES

On the vast truck-gardening acreage of King Farms Company adjoining the site a plow (upper-right) began turning over the earth early in March, as has been the custom for many years. The lower picture is a panorama of the King packing house and farming and motive equipment. Within the steel-company enclosure different kinds of earth-moving machines were hitting their stride. The bulldozer shown at the upper-left was moving ties into position for railroad tracks. All the property of another truck-gardening concern—Starkey Farms—has been acquired by U. S. Steel.

principal personnel for operating the new plant. Albert J. Berdis, who helped design the Fairless Works, will be its general superintendent. He has previously served as superintendent of the U. S. Steel plant at Vandergrift, Pa., and as assistant superintendent of the Irwin Works in the Pittsburgh area. It is expected that the plant will employ 4400 in the operating division and some 500 office workers. An employment office has been opened on the site and is taking applications for jobs that will start next September. On one day during the first week in March 3000 persons filled out blanks.

The coming of the steel mill to this rather quiet section of Pennsylvania will have tremendous local effects. Morrisville, a community of 7000 residents many of whom work across the river in Trenton, is already feeling the impact. Real-estate prices have doubled or trebled. With construction workers pouring in daily, sales of overalls and other work clothes have zoomed. With the surety that satellite industries will gather around the steel producer, it has been estimated that as many as 70,000 additional jobs will be created in the section during the next five or ten years.

The Morrisville Bank, which has a force of nine people now, will double the size of its building immediately, and other businesses are planning expansions. Even the churches are thinking along the same lines. Two housing projects have already been launched. One will be a 300-acre, 1200-home development. The town has authorized an expenditure of $3,000,000 for a storm-sewer system, something it has gone without in the past.

In his remarks at the ground-breaking ceremonies, Mr. Fairless called attention to the fact that during the Revolutionary War the area around Morrisville and Trenton was one of the nation's most important iron-making centers. "Now that our liberties are again threatened," he stated, "I think it is not only fitting but indeed significant that the iron-and-steel industry should return today to its historic home here on the banks of the Delaware, to embark upon the largest single expansion project that has ever been undertaken in its entire history."

No less a personage than William Penn, founder of Pennsylvania, inspired the early settlers to develop an iron industry. Interested, because he owned iron furnaces at Hawkesworth, England, he encouraged the colonists to search for and exploit ore deposits in his domain. It is worthy of note that, while other sections had built forges, there was none in what is now Pennsylvania before Penn arrived. In Berks County, just west of the one in which the Fairless Works will rise, Thomas Rutter established the state's first ironworks in the vicinity of Pottstown in 1716. Also nearby, at Cornwall, Peter Grubb set up a bellows-blown blast furnace in 1742. In the same general area was Elizabeth Furnace, which was operated for a time by Baron Heinrich Wilhelm Stiegel, who afterward gained fame as a glassmaker.

END OF AN ERA

The section that has been devoted to farming since the rule of William Penn began 269 years ago is feeling the effects of industrialization and undergoing sweeping changes. All but a few existing structures are being moved or razed. At the left, a house purchased by a homeseeker for use elsewhere is being blocked up for moving. The stone Quaker meeting house pictured at the right was erected in 1818 and is the oldest house of worship on the tract. It is being torn down. Some of the large structures will be occupied for the time being by the contractors' staffs.

In the hands of Robert Coleman, Elizabeth Furnace made cannon and shot for the Revolutionary War troops. Even closer to the new mill was Durham Furnace, near what is now Riegelsville, Pa., which, from 1727 on, shipped its products down the Delaware to Trenton and Philadelphia in a distinctive type of craft that came to be known as the Durham boat. Iron was first successfully manufactured in New Jersey in 1730 in a rebuilt furnace that had been put up earlier at Mount Holly, just a few miles from the U. S. Steel plant tract. One small establishment in Trenton made steel during the American Revolution, and the present Trenton Works of the American Bridge Company is on the spot where the first open-hearth furnace in the United States was founded in 1868.

The environs of the steel-plant site are of great general historical interest. Approximately 12 miles upstream, Gen. George Washington and his troops, using the Durham boats just mentioned, crossed the Delaware on Christmas night in 1776 and then marched down to Trenton for the surprise attack on the Hessians that turned the tide of the war. A granite monument in Trenton marks the location where Washington's batteries opened fire. General Ewing's Corps, which also was to have crossed the stream but found it impossible because of the ice, was stationed a short distance westward of where Morrisville now stands.

Morrisville was named for Robert Morris, who is credited with having financed the War of Independence. He headed committees in the Continental Congress charged with raising funds in 1776-78 and was later chosen superintendent of finance. It is said that his credit as a successful Philadelphia merchant was better than that of the Government. At times, when he could not requisition sufficient money for the troops from the colonies or borrow it, he dug into his own pocket. The first covered bridge of record in the United States was constructed across the Delaware between Morrisville and Trenton. It was 1025 feet long and was opened to traffic on January 30, 1806.

Bordentown, N. J., 5 miles below Trenton and almost directly across the river from the point where the Fairless Works will be situated, was the home of Thomas Paine, whose pamphlets, *Common Sense* and *The Crisis*, had much to do with arousing public opinion in favor of the Revolution. Francis Hopkinson, a signer of the Declaration of Independence, also lived there, and his body lies in Christ's Churchyard. Clara Barton, organizer and first president of the American Red Cross, taught school for a time in a small building on Crosswicks street. That structure is still preserved. Joseph Bonaparte, brother of Napoleon and for a brief period king of Spain, established residence in 1830 at "Bow Hill," a colonial mansion between Bordentown and Trenton. Prince Napoleon Lucien Charles Murat, whose father, Joachim Murat, succeeded Joseph Bonaparte in 1808 as king of Naples, resided in Bordentown for a few years. He returned to Europe in 1848 and took part in the French Revolution. He was recognized as a prince of the royal blood by Napoleon III.

The first passenger-carrying railroad of any consequence in America ran from Bordentown to South Amboy, N. J. The famous locomotive "Johnny Bull," that was brought from England, made its trial run there, and the starting point is marked by a monument. Passengers from Philadelphia came up the river by boat and transferred to the railroad coaches at Bordentown. John Fitch, early steamship builder, operated a passenger and freight service on the Delaware between Philadelphia and Trenton in 1790.

The steel-mill site may be said to lie in the cradle of Pennsylvania, for it was included in the manor estate of William Penn whose country home, Pennsbury, was on the Delaware only a few hundred yards downstream from the southern boundary of the tract. Penn arranged for its construction during his first visit to the province between 1682 and 1684, and directed the work by voluminous correspondence after his return to England. During his second stay in America, from 1699 to 1701, Penn and his wife Hannah spent much time at Pennsbury, where they entertained not only visiting dignitaries and white neighbors but also the Indians, with whom Penn always maintained friendly relations. It is reported that nineteen treaties with the Indians were signed in the manor house.

It was there, too, that Penn studied and approved the Charter of Privileges which was, in effect, the constitution of Pennsylvania until 1776.

The Pennsbury manor estate consisted of some 8000 acres and extended for 5½ miles along the river. In addition to a 3-story mansion with ground dimensions of 60x40 feet, there was a separate bake-and-brew house, an office, a smokehouse for curing meat, a stable for twelve riding horses, and some smaller buildings. In front of the mansion, which faced the Delaware, was a formal garden. Elsewhere on the property were vegetable and herb gardens, and about 40 acres was planted in orchards.

Following Penn's return to England, the house was unoccupied and rapidly fell into decay, largely because of leakage in a leaden reservoir that was mounted on top of the structure to capture rain water. When Penn's son Thomas visited the property in 1736 he found it "very near falling, the roof as well as windows, and the woodwork almost rotten." Years later, in 1797, another observer reported that it was but the ruins of an "ancient pile, some of the very thick walls still remaining, the Lintal that was over the door lays near the ruins dated 'W 83 P' scarcely legible."

Fortunately, the entire premises have been restored in recent years so nearly like they were as to be called 95 percent authentic. When the Warner Company established its sand-and-gravel business in the section, it acquired ownership of the property, and Charles L. Warner became greatly interested in it. He even conducted research in England and had a large map prepared showing Penn's Province as it was during the time he lived at Pennsbury. The map, based on one started in England in 1681, hangs in the hallway of the restored mansion. All the territory that was then settled is shown on it divided into three "counteys"—Bucks, Philadelphia, and Chester.

In 1932, Warner Company gave eight acres, including the building area and its immediate surroundings, to the Commonwealth of Pennsylvania. At the time it was thought that a memorial park might be created there, but before removing the ruins and grading the grounds the Pennsylvania Historical and Museum Commission authorized a thorough archaeological investigation under the direction of Donald A. Cadzow. For two years crews dug carefully and discovered the foundation walls, part of the stone floor of the cellar, traces of walks, the garden wall, and miscellaneous objects such as door latches, fireplace tiles, handmade brick, roofing tiles, window brace irons, shutter fastenings, and even an iron hoop from one of the wooden vats in the bake-and-brew house.

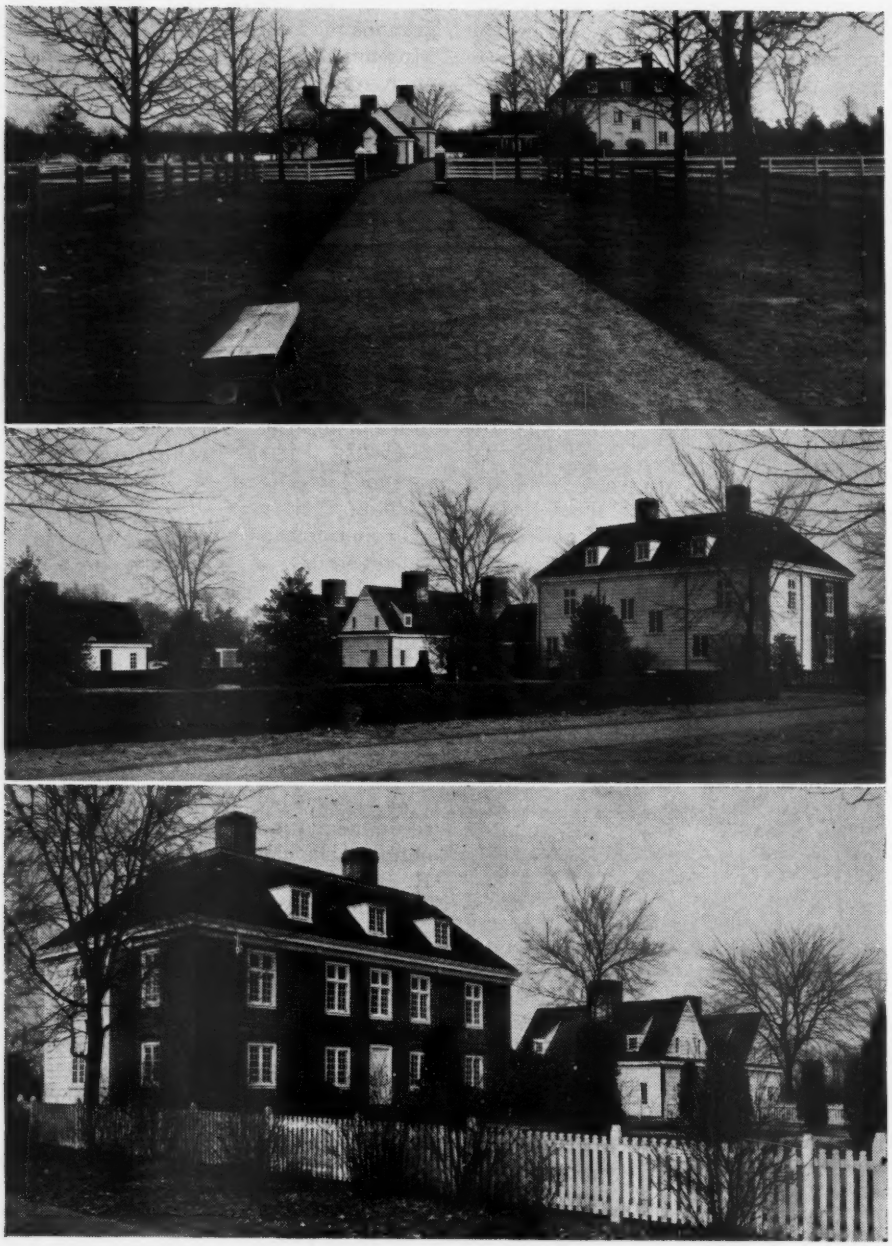
Meanwhile, Charles B. Montgomery and John M. Okie, who had been delving into old records, met with similar success. The original plans were found, as well as a wealth of other helpful data. William Penn was such a meticulous man that he had had his secretary make an inventory of the mansion, which showed the dimensions of each room and listed its furnishings. Penn's letters also contributed much information, as he wrote in great detail from England as to what he wanted done on the premises. Even the sizes and details of the formal garden plots and plantings were uncovered.

In view of these findings, and upon the recommendation of a committee of architects, the commission, in 1936, asked R. Brognard Okie to prepare plans for rebuilding the manor house and auxiliary structures. The work was finished in 1939. Later, the gardens and grounds were restored essentially as they had been in Penn's day, the only major deviation being roads, parking lots, and paths for the convenience of tourists.

The commission then undertook to furnish the Manor House and was given valuable assistance by a committee of interested citizens headed by Miss Sarah D. Lowrie. It was impossible, of course, to duplicate Penn's rugs, furniture, draperies, and pictures, but great care was taken to provide authentic pieces. Some articles from the original structure were traced to their present owners and a few

PENNSBURY MANOR AND THE RIVER

Restored to its original condition in virtually every detail, William Penn's country estate is maintained by the Commonwealth of Pennsylvania with attendants on hand throughout the year to guide visitors around. Here it is shown as it looks from the bank of the river. The wall below the white fence is built of bricks from the original house, which was but a pile of rubble when restoration began. Bordering the walk are poplar trees such as were originally planted there in 1685 by Penn's direction. In a similar manner, practically everything has been re-created essentially as it had been. On the broad Delaware (right) Penn traveled to and from Philadelphia on a barge rowed by six oarsmen. The docks of the new steel plant will be excavated on the left bank at a point about 400 yards distant.



OTHER PENNSBURY VIEWS

Top– As the entering visitor sees the buildings. Center– View from the northwest showing, left to right: office, smokehouse (partly hidden by tree), brewhouse, bakehouse, and manor house. Bottom– View from the southwest. Just inside the fence is the formal garden, laid out and planted as Penn's careful records showed it had been arranged. Notice the half brick-half frame construction of the manor house. The original bricks were shipped from England, as were window glass, hardware, and many other items. When a shipment of bricks was delayed, Penn wrote his agent to finish the structure with wood.

of them acquired. The completely recreated Pennsbury was finished in 1946 and is open for inspection throughout the year. The superintendent, T. Russell Stackhouse, and a staff of well-informed attendants conduct visitors over the premises and answer questions.

As has been mentioned, William Penn lived peaceably among the Delaware Indians while at Pennsbury and frequently had them as guests. They came to respect and trust him, and it is not of record that he ever treated them unfairly. As much cannot be said, however, of some of his successors, who were prone to take advantage of the simple-minded natives for their personal gain. One dark chapter in the history of their dealings with the red men was written in the Pennsbury area. That was the so-called "Penn's Walk," or "Walking Purchase," which so embittered the Delawares that they massacred 60 or more settlers during the French and Indian War and spread terror among others.

When Charles II of England granted Penn the charter of the Province of Pennsylvania on March 4, 1681, to settle a debt the crown owed Penn's father, nothing was said about the rights of the Indians to the land, but Penn planned from the outset to recompense them for the loss of territory. Even before he came to America he instructed his agent, William Markham, to deal fairly with them, and it was he who bought the ground on which Pennsbury was built. After his arrival, Penn made various other purchases, thereby progressively extending his holdings northward and westward as prospective settlers made known their desires to buy ground from him. Each purchase by Penn was validated by a treaty, and it was customary to specify the land involved in terms of the distance a man could walk in a given time.

There is some uncertainty as to whether the walk which concerns us here was based on an actual contract or on an imaginative one that the Indians were talked into believing they had signed. One version of the story is that William Penn, or his agent, and the Indians signed papers in 1682 that gave Penn title to the land extending northward from Pennsbury the distance of a 3-days' walk. According to this account, Penn personally walked with the Indians along the Delaware River, setting a leisurely pace and pausing now and then to smoke with them. After proceeding for a day and a half, Penn is supposed to have said that the ground they had gone over gave him all the property he wished. Some 50 years later his son Thomas reportedly came across the agreement and insisted that only half the land stipulated had been turned over and persuaded the Indians that they still owed as much territory as a man could cover on foot in a day and a half. In the other version, Thomas Penn convinced the Indians that there was a walking-purchase deed drawn in 1686 and that, as it was never fulfilled, he was entitled to additional land.

Some credence is given to the first story by reason of the fact that the walk that was undertaken later was begun at a chestnut tree at Wrightstown which marked the western end of a line drawn from the point on the Delaware where William Penn's earlier walk had terminated. In any event, Thomas Penn prevailed in his contention that an old agreement existed and that the Indians had not lived up to it. Before the Delawares submitted, however, the matter was discussed at three parleys extending over a period of several months. The first one was held at Durham Furnace in 1734, the second at Pennsbury on May 5, 1735, and the third at Philadelphia on August 25, 1735. Two Indian chiefs, Tischcohan and Lapowinsa, attended the final meeting.

It is plain that, regardless of whether or not there was any documentary basis for the action, Thomas Penn and his associates deliberately planned to outwit and rob the Indians. Even before the

negotiations were completed, secret walks were made by picked men to determine how much territory could be obtained, and certain objectives were set. One trial walk was taken by James Doane in 1735, and on his return trip he blazed trees so that his course could be followed later.

In order to cover as much distance as possible, Penn enlisted the best walkers available by offering a prize of land to the winner. It thus took on the aspect of a contest, which was contrary to the way William Penn had conducted the affair previously. Three contenders, Edward Marshall, Solomon Jennings, and James Yeates were on hand at Wrightstown at sunrise on the appointed day, September 19, 1737. Also present were John Chapman, the surveyor-general; Timothy Smith, the sheriff, with two of his deputies; and several other white men, some on horseback. Three young Indians were among the group to make the walk for their tribe.

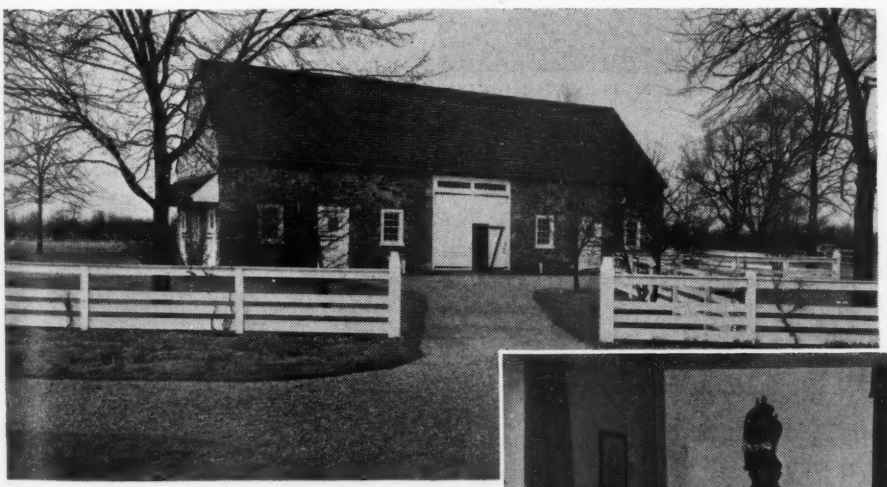
When the signal was given, the three white men took off on a northwesterly course as fast as they could go. They followed a road that eventually ran from Philadelphia to Durham Furnace, but the northern end of which was then still uncompleted. It led them through Pineville and Buckingham and thence to Tohickon Creek, where they struck off through the woods on an Indian trail. By noon they had covered 29.9 miles and paused for lunch in a meadow on the farm of Mary Wilson, a widow, 3 miles west of Durham Furnace. That point on Cook's Creek in Springfield Township, Bucks County, is now marked by a monument. Jennings, finding the pace on a warm day too fast for him, had dropped out 10 miles back. After a stop of only fifteen minutes, Marshall and Yeates set out again. The three Indians, aware by then that they were being bilked, left in disgust.

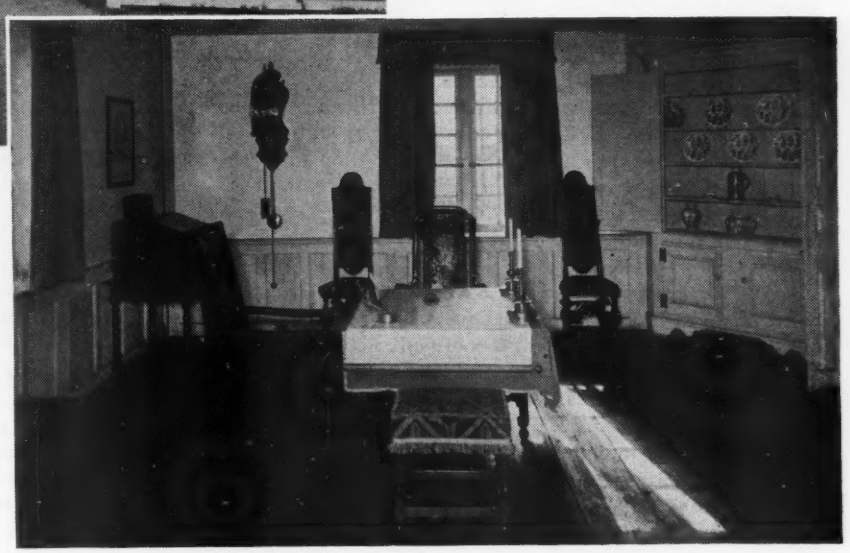
The Lehigh River was forded at Jones Island about a mile east of the present limit of Bethlehem, Pa. Shortly afterward, Yeates, who had been imbibing freely of toddy proffered him by the accompanying party on horseback, succumbed to its effects and fell into the river, probably near Lehigh Gap. Marshall pressed on until fifteen minutes after sunset to make up for the time lost at lunch. He had gone 44 miles. The following morning he did not get started until two hours after sunrise, so walked until two in the afternoon. He halted about 3 miles east of Mauch Chunk, Pa., some 65 miles from the starting point.

Aside from the race aspect of the event, the Indians claimed that they had been swindled in other ways. They had expected, they asserted, the route to follow the Delaware River more closely, and that the land they would forfeit would consist of a fairly narrow strip between the path taken by the walkers and the stream, with the northern limit determined by a line drawn from where the walk ended to the closest point on the Delaware. Actually, Penn and his conspirators ran a line from the terminal to the river at a right angle to the course of the walk. Had it extended to the nearest point on the Delaware, it would have met the stream somewhere above Easton, Pa. Instead, it stretched 66 miles to Parker's Glen about 5 miles below the confluence of the Lackawaxen and the Delaware. The extra territory exacted from the Indians by this maneuver amounted to around 750,000 acres and included their favorite Minisink hunting grounds between Delaware Water Gap and Port Jervis, N. Y.

Smarting under this treatment and lesser causes for grievance, the Delawares became more embittered during succeeding years and began a series of depredations in 1755, killing all the settlers in their lost domain who could not escape and burning the homes of those who fled. They did not, however, molest the Depuys, descendants of early Dutch settlers near Shawnee, Pa., who had purchased their land from them and always lived at peace with them. Marshall, the most hated of all, was their especial quarry, but he eluded efforts to capture him by fleeing to New Jersey, although his wife and 14-year-old daughter were killed in the first attack and his oldest son, Peter, met a similar fate later. Marshall came back to Pennsylvania, settled on an island in the Delaware in Bucks County, and died a natural death there in 1789.

Complaints of the Indians concerning the walk reached England, and the king ordered an investigation in 1756, with Benjamin Franklin in charge. Franklin, however, spent the period from 1757 to 1762 in England and never had an opportunity thoroughly to probe the episode. Cowed and discouraged by the train of events, the Delawares yielded the land covered by the "Walking Purchase" and, in the end, moved on westward.

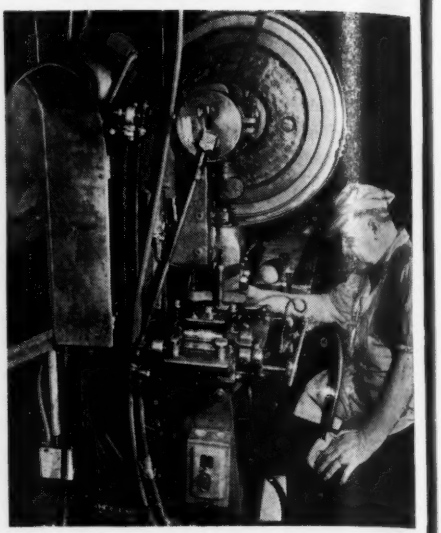




PENN'S STUDY AND STABLE

Furnishings throughout the house are authentic as to period. The leather chair (picture at right) is mentioned in Penn's writings and is said to be the one used by him. The clock on the wall, still running regularly, bears on its brass dial the date 1680 and the name of its maker, Ed. Cockey, Warminster (England). It has only an hour hand. Floor boards range up to 24 inches wide and are all of hand-planed oak. Shown above is Penn's stone stable in which the stalls are as they looked originally. At one time it housed twelve riding horses.

Air Power Gives Crosley a Helping Hand



APPLICATIONS OF AIR

At the left is a section of the radio-set production line showing small pneumatic tools suspended at intervals. Overhead are the air-delivery lines with take-offs for the tools that embody a combination moisture separator and air-line lubricator. Balancers that hold the tools out of the way when they are not in use are hidden behind the beam below the air piping. Above is pictured a shearing and stamping machine in which small nuts are formed from bar stock. After the first operation has been completed, the piece is moved to the next position by a blast of air that issues at the proper instant from the curved pipe in front of the operator. This arrangement not only expedites the work but also eliminates the hazard of hand injuries.

PHOTOS AND DATA FROM COMPRESSED AIR AND GAS INSTITUTE

THE automobile assembly line, which typifies volume production in the average person's mind, has many counterparts in modern American industry. Numerous household articles such as refrigerators, radio and television receivers, and electrical appliances, are put together in this manner. Most of the lines make liberal use of pneumatic tools; in fact, they depend for much of their speed and economy of operation on the quick action and ease of handling that are characteristics of these air-powered aids. Wherever holes are to be bored, nuts to be run, or screws to be driven they save time and human effort and perform their allotted tasks efficiently, uniformly, and untiringly.

In the Cincinnati plant of Avco Manufacturing Corporation's Crosley Division, radio and television sets are assembled on three long lines, and a second television line is being made ready to function. As is usually the case where small, light parts are handled, the work calls for dexterity and is carried out by young women. Along the lines and suspended within convenient reach from overhead balancers are small pneumatic screw drivers, wrenches, and similar tools, each of which is sized for the particular job in hand.

In addition to running tools, compressed air actuates clamps that grip assemblies firmly while they are being joined. Typical of such facilities is a cylinder-operated fixture that assists in cementing speaker cones and companion parts. After a quick-acting cement has been applied, the components are brought together and held tight until they are bonded sufficiently to permit the assembly to be handled. The entire job does not take more than a minute or two.

Aside from its applications on assembly lines, air is employed for varied purposes throughout the plant. In the machine shop it performs such services as indexing work and blowing chips from machine tools, as well as cleaning motors. Besides expediting operations, air power has in some cases also eliminated hazards to which workmen would be exposed if they were required to do the jobs manually. For example, a stamping machine in which special small rectangular nuts are formed has been safeguarded in this way. Pieces of suitable size to make a nut are sheared from bar stock on a timed cycle and each one drops into a recess in a die, from which, at the proper instant, a blast of compressed air blows it into position for further processing. The whole sequence is automatically controlled and synchronized, and the air jet functions for only a fraction of a second. By this arrangement the operator's hands are never in jeopardy.

Although there are hundreds of uses of air, each one needs only a small volume, and as the demand in every case is periodical rather than steady, all of them combined are normally supplied by a compressor that delivers a little less than 1000 cfm. During peak periods another machine of approximately 500 cfm. capacity is cut in. On the night shift the latter carries the full load. A third unit furnishes air at 400 psi. pressure for special testing work. Although the plant is only of moderate size, with a payroll of around 1800 persons, it has 7½ miles of air distribution lines.

Evaporative Coolers

New Comfort Aids Are Based on Same Principle as Olla and Canteen

John L. Parker

BETTMANN ARCHIVE PRINT

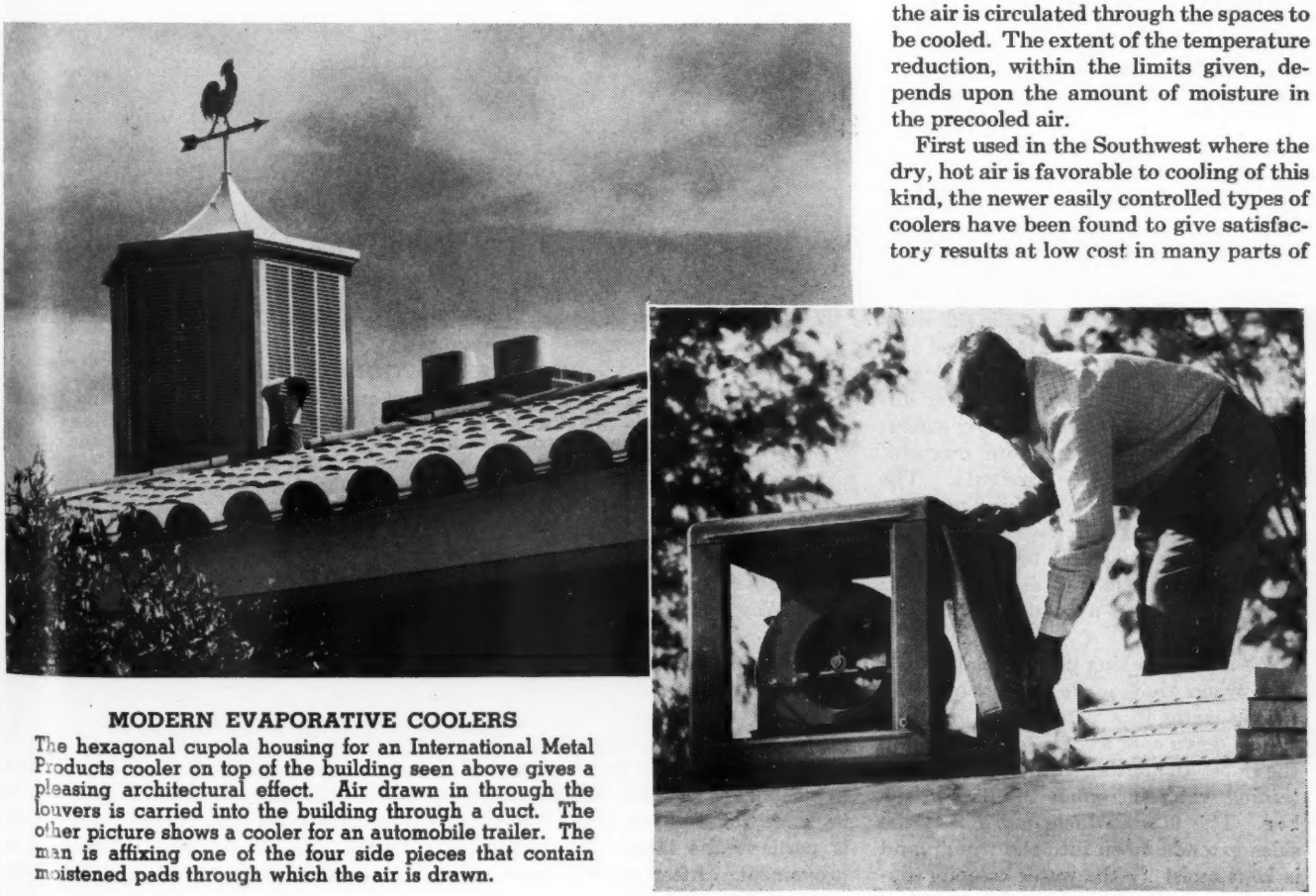
FILLING CANTEENS

The traditional soldier's canteen provides a simple example of evaporative cooling. One of the men shown in this old print of Civil War troops pausing for refreshments is offering his for filling.

WE HAVE published a number of articles dealing with vacuum-type refrigeration units wherein some of the water circulated is caused to flash into vapor by lowering the pressure on it sufficiently to reduce its boiling point. The heat required to effect vaporization is drawn from the remaining water, which is consequently cooled. This article concerns another type of evaporative cooler—one that acts on the same principle but at a slower rate because it operates at or close to atmospheric pressure. Because comparatively little heat can be extracted under these conditions, the cooling effect is relatively low. However, such coolers have been used successfully in some sections for many years, and recent improvements in design have widened their field of service.

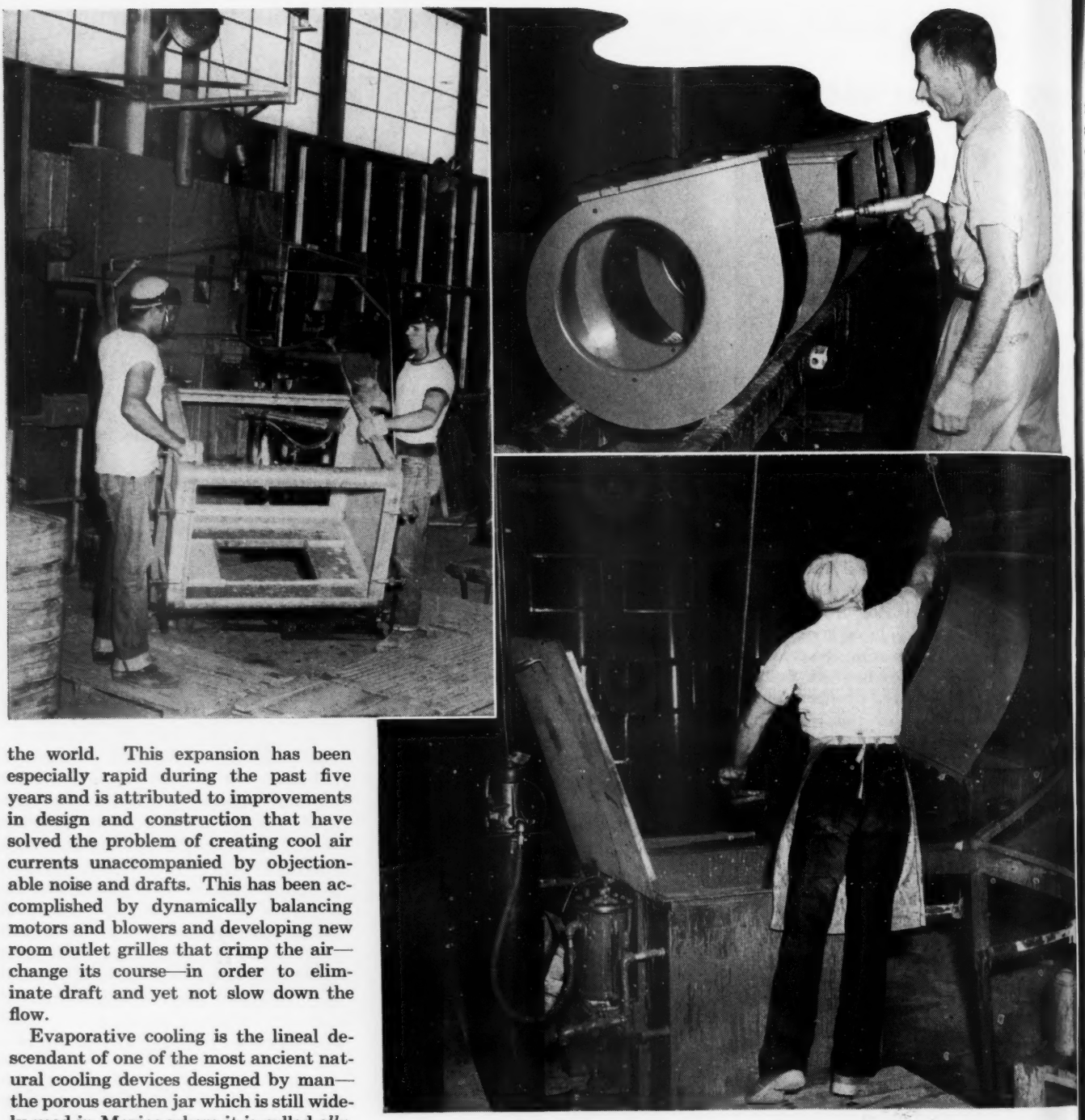
This simple method of evaporative cooling is achieved by drawing air over water-soaked fiber pads. In the process of converting some of the liquid in the pads into vapor the temperature of the air is lowered from 6 to 20°F., and then the air is circulated through the spaces to be cooled. The extent of the temperature reduction, within the limits given, depends upon the amount of moisture in the precooled air.

First used in the Southwest where the dry, hot air is favorable to cooling of this kind, the newer easily controlled types of coolers have been found to give satisfactory results at low cost in many parts of



MODERN EVAPORATIVE COOLERS

The hexagonal cupola housing for an International Metal Products cooler on top of the building seen above gives a pleasing architectural effect. Air drawn in through the louvers is carried into the building through a duct. The other picture shows a cooler for an automobile trailer. The man is affixing one of the four side pieces that contain moistened pads through which the air is drawn.



SHOP APPLICATIONS OF AIR

Tops and bottoms and other frame members are clamped together and then joined into a solid piece by an air-operated arc welder (upper left). Holes for mounting blower housings on base plates are quickly made with a pneumatic drill (upper right). Other air tools drive screws and run up nuts in assembly work. Blower housings are dipped in enamel that is continually agitated with compressed air (above).

the world. This expansion has been especially rapid during the past five years and is attributed to improvements in design and construction that have solved the problem of creating cool air currents unaccompanied by objectionable noise and drafts. This has been accomplished by dynamically balancing motors and blowers and developing new room outlet grilles that crimp the air—change its course—in order to eliminate draft and yet not slow down the flow.

Evaporative cooling is the lineal descendant of one of the most ancient natural cooling devices designed by man—the porous earthen jar which is still widely used in Mexico where it is called *olla*. Its pervious walls allow water to seep through, and as it reaches the outer surfaces some of it is evaporated by atmospheric currents, the resultant temperature drop cooling the contents. The cloth-covered canteen that was part of a soldier's equipment in days gone and the cowboy's canvas saddle bag were based on the same principle and kept their drinking water at a palatable temperature.

Westward-treking pioneers copied the idea when they made food coolers by letting water in a pan on top of a box trickle down over a coarse cloth covering the sides. In another form, a trough containing water surrounds the base of the box. The fabric which hangs over the sides extends down into the trough and is kept moist by the water creeping upward continually by capillary attraction. Such coolers are still used in many parts of the West and are placed outdoors, on a porch, for instance, where air is stirring.

From these simple basic designs have come the modern streamlined, efficient evaporative coolers. The latter are gleaming, virtually all-metal one-piece units that can handle large volumes of air in a small space. This increase in capacity and, therefore, cooling effectiveness, is perhaps the latest outstanding improvement. After several years of research with that aim in view, the International Metal Products Company, of Phoenix, Ariz., developed new types of blowers and fans for its coolers, with the result that they deliver from 2000 to 20,000 cfm. of air, depending upon the size. This concern, one of the leaders in the field it serves, is headed by two brothers, Adam and Gust Goettl, members of a family in which there have been metalworkers over a span of 400 years. Adam, the firm's president, started out in a metal shop at the age of fourteen.

Both brothers once did research and development work for Westinghouse Electric Corporation.

International Metal Products was the first company to turn to organized research in an effort to improve the evaporative type of cooler by increasing its efficiency and thereby its popularity and sale. The first component singled out for betterment was the only nonmetallic part: the replaceable fiber pads of aspenwood that are packed into removable grilles which form the sides of the cooler box.

It was obvious that a pad twice as thick as the 3-inch one normally used would provide a much greater evaporative surface for cooling the air. But because bulkiness was undesirable and thick pads would bring other problems in their train, the investigators considered the possibility of preparing the aspen fibers in some way so that the same thickness would serve; that is, expose more water to the evaporative effect of the air. Continuing research revealed that when the fibers were subjected to a simple chemical treatment they would absorb water 30 times faster than the natural wood. However, with constant soaking the chemical washed out and weakened the cellulose structure of the fibers.

After more experimenting, the company produced a complex chemical that does the job effectively and lasts the life of the fibers. The next step was to add something to minimize the growth of algae on the cooling pads as the water keeps on circulating. This, together with the rot problem, was surmounted by designing a streamlined pad grille with louvers that permit an uninterrupted flow of air and admit beneficial ultraviolet rays from the sun.

Up to that time the units were being operated so as to discharge air into the spaces to be cooled. This created drafts and caused some noise. In an effort to eliminate these undesirable by-products, the Goettls tried exhausting the air instead of pushing it in. The new method proved to be far superior to the old, and some coolers now being placed in service are of that type.

The cooler is stationed at a window or at some other opening in the lower part of a structure, and an exhaust blower is located on the roof. By this system, warm air is withdrawn and cool air from the evaporator enters as a gentle, even-flowing current. The change not only solved the draft and noise problems but also stepped up the efficiency of the unit because it reduced the pressure of the air slightly and thereby augmented its evaporative effect. Moreover, it lowered the relative humidity of the circulating air and, consequently, made for greater comfort.

PREPARING FIBER PACKING

Resembling hay, the aspen-wood fiber is received in bales. After being dipped in a chemical to increase its capacity to absorb water, it is fluffed and placed in the pad racks.

International Metal Products turns out 35 standard and ten special models and sizes of coolers in a plant that covers 100,000 square feet of working area. Both in making up the components and in assembling them into complete units, compressed air performs many services. It is supplied by small compressors installed near the points of use, four of them being Ingersoll-Rand Type 30 machines with V-belt motor drives.

Seamless, one-piece bottoms and tops for the cooler cabinets are formed on a 400-ton drawing press; connecting bars for the framework are stamped by a battery of presses; and a second group turns out grilles for the pad racks and blowers from sheet-aluminum stock. Various subassemblies and the final cabinets are spotwelded into rigid and vibration-free units on semiautomatic machines controlled by air power.

Blower housings are dipped in enamel, which is continually agitated in its vat by compressed air, and are then oven-baked. Box frames are spray-enameled in booths. On the assembly line, where blowers and motors are mounted in the cooler cabinets, air-operated drills and wrenches speed up the work and reduce muscular effort. Each cabinet is fitted with the proper pad racks, which have been made up and filled with treated aspen-wood fibers in another department. The completed units are rolled into the warehouse at the end of the assembly line.

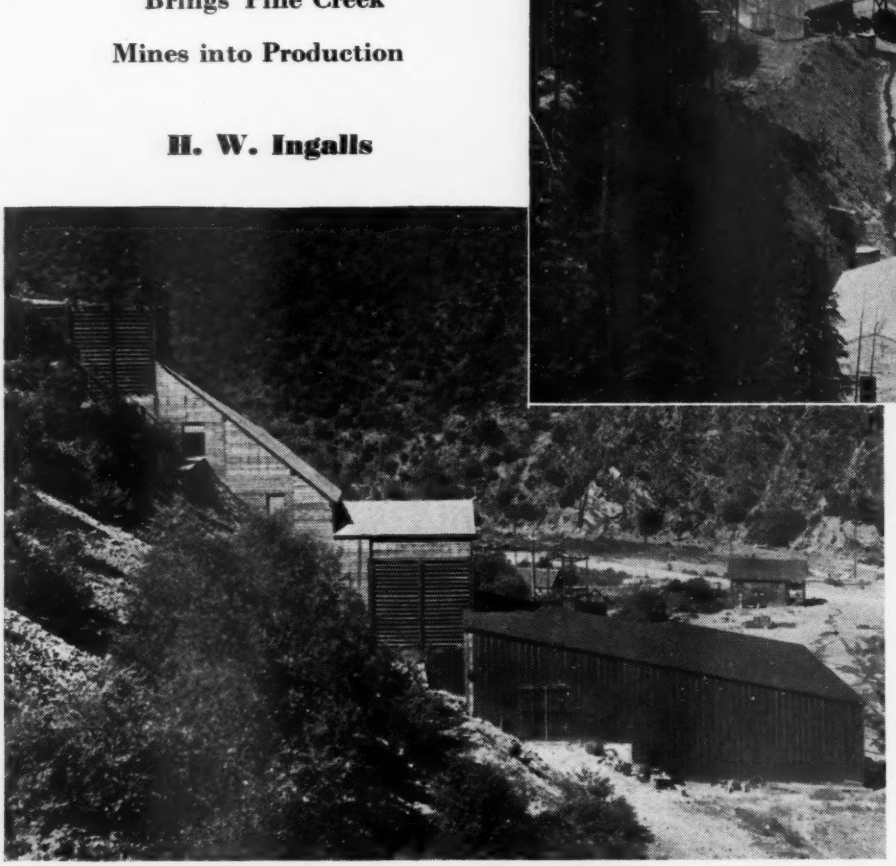
A soundproof laboratory occupies a section of the main factory building and houses a wind tunnel in addition to special testing equipment for studying problems relating to the concern's activities. Through its research efforts, it has not only increased the application of evaporative coolers in the usual fields of comfort cooling but has also developed some units for special purposes. In the latter category is a combination cooler, dust filter, and electric heater that is installed in power shovels built by the Harnischfeger Corporation, of Milwaukee, Wis. Designed to provide operator comfort in dusty atmospheres, in either hot or cold weather, and to protect the working equipment in the cab, this unit is the outgrowth of experiments carried on in coöperation with Phelps Dodge Corporation in open-pit copper mines in Arizona. Similar air-cooling and filtering units have been produced for Westinghouse electric mine locomotives.

The company's busy season commences in October, when it begins to fill contracts with large distributors who market the coolers under their own brand names. These orders are usually disposed of by the first of the year, when the firm starts making standard and special units that are sold direct to users. Operations halt in August for vacations and factory changeovers required by model changes.

Zinc in the Coeur d'Alenes

Flotation Milling Process Brings Pine Creek Mines into Production

H. W. Ingalls



SIDNEY AND NABOB

The ore body of the Sidney, largest Pine Creek producer, was located by diamond drilling from the surface by the U. S. Bureau of Mines. The 300-ton milling plant is pictured at the right. The Nabob, which adjoins the Sidney, recently came into production. Its mill, above, is the only one in the Coeur d'Alenes without windows. The interior is illuminated with fluorescent lights.

A FEW years ago, the Pine Creek area of the Coeur d'Alene mining district of Idaho was just prospecting territory; today it is the largest zinc-producing region in the nation's leading zinc-producing state and boasts four mines that pay dividends regularly and two potential dividend payers. Eight modern flotation milling plants, with a total rated capacity of 1650 tons per day, ship a high-grade zinc concentrate by truck to the nearby Sullivan zinc plant and a by-product of a lead-silver concentrate to the Bunker Hill smelter.

The known productive area measures about 8x3 miles, and begins roughly 4 miles south of the great Bunker Hill & Sullivan silver-lead-zinc mine and reduction works. Although long known to be rich in zinc, its development was retarded because of metallurgical complications. The Coeur d'Alene became essentially a lead-mining district at an early stage, for zinc was so difficult to extract that treatment rates on ores containing appreciable amounts of the mineral were set high enough by smelters to discourage its mining. Better days came with the introduction of the selective-flotation process of milling. Recent increased activity has, of course, been accelerated by the favorable price for zinc.

The largest mine in the section is the Sidney, with a dividend record of $2,058,750 at the close of 1950 and a gross output of approximately $12,000,000. It has an ore body proven for a length of 1000 feet and widths up to 15 feet and been developed to a depth of about 2000 feet, all practically virgin territory to the surface.

The Nabob property adjoins the Sidney on the west and has been opened on a level some 600 feet deeper than the latter by a large, straight crosscut tunnel which cuts through two wide mineralized zones, each carrying a series of three mineral-bearing veins. The most prominent of these in the first series, in a wide structure of Prichard quartzite, is the Crystolite. Lateral development proved the vein to contain commercial-grade zinc-lead ore throughout a width of 17 feet, and it has been opened for a length of 700 feet. During 1950 the company spent $100,000 in prospecting and preparing it for production, and has now started milling the development ore. It recently purchased the Shetland group of claims on the westerly strike of the Crystolite vein.

The original Nabob vein at the end of the long crosscut tunnel is the westerly extension of the Sidney and its upper workings, which are now under lease, have yielded heavy returns and paid $51,195 in royalties during 1950. The tunnel exposed this vein system where it was disturbed by the McDougall fault and at a considerable distance west of and below the upper workings. Drifting east on this structure has been delayed on account of the activity attending the opening of the Crystolite structure, but it will be continued when production of ore from that source is underway.

The Sunset Minerals property, the old Liberal King, is also west of the Sidney and has been under development for several years. It has just distributed its initial dividend, a modest $47,865. The company is operating down to the 1400-foot level, milling 3000 tons per month with mill feed averaging 13 percent zinc, 8 percent lead, and 2.8 ounces silver per ton.

The Little Pittsburgh Mine is on a parallel fissure south of the Sidney and is owned by the Pine Creek Zinc-Lead Company. Since 1942 it has been leased

to the Denver Development Company—a group of local miners—that has opened the ore shoot down to the 800-foot level. It has produced and milled 241,541 tons of ore, which has returned net smelter settlements of $2,017,995. The owners have collected $343,059 in royalties and passed on to stockholders approximately $141,427 in dividends. The lease has now expired and the property has been taken over by the Mascot Mining Company, an Idaho corporation.

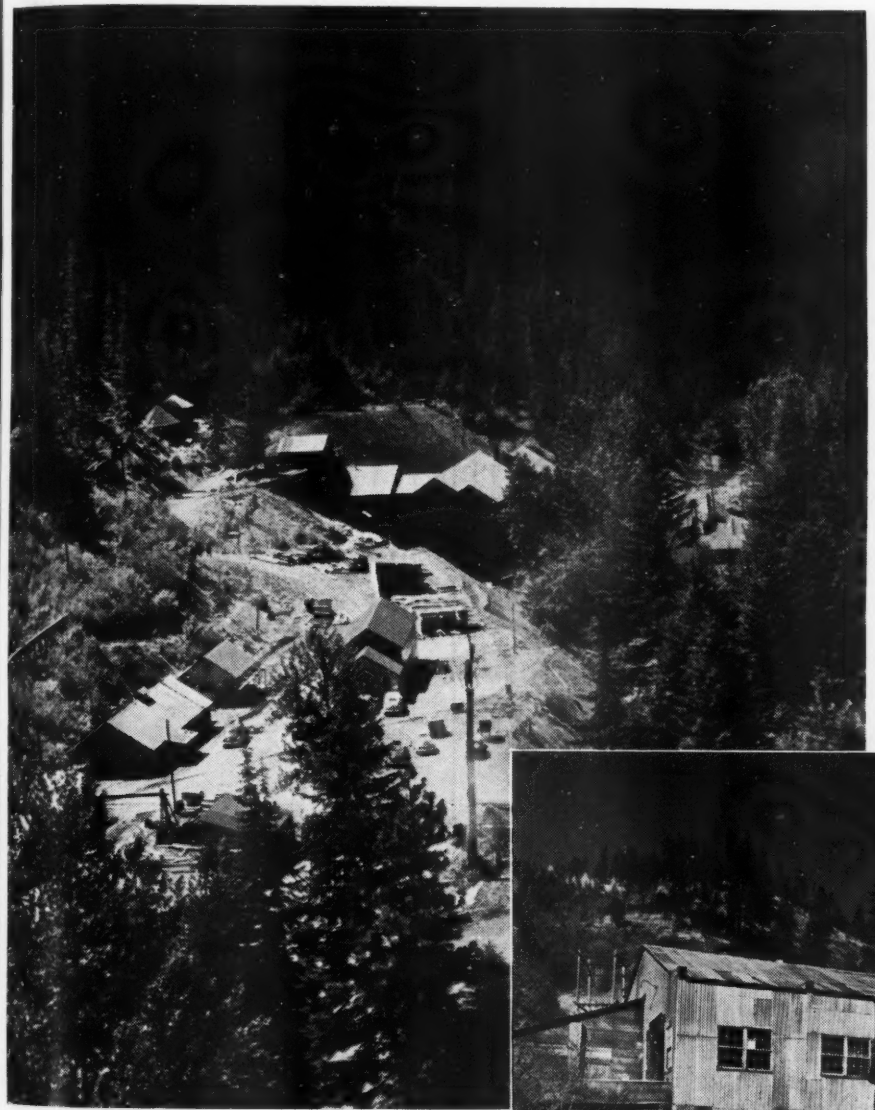
Just east of the Sidney, the Highland-Surprise Company has recently expanded the capacity of its milling plant to 300 tons daily. With several ore bodies under development down to the 1450-foot level, it is producing at the rate of 100 tons daily. This organization has declared a total of $177,536 in dividends but is not yet on the regular paying list.

South of the Highland-Surprise is the Douglas Mine, which was worked during the first World War under lease by the Anaconda Copper Mining Company. The zinc was shipped crude to the Anaconda smelter. During that period the owners distributed $38,413 in dividends from royalties received. Later the property was purchased by the Bunker Hill & Sullivan and the Hecla Mining companies and was leased to the Small Leasing Company, which constructed a 150-ton flotation mill and operated for several years, paying an undisclosed sum in royalties. The mine is now idle.

The Spokane-Idaho is a rebirth of the Old Constitution Mine that was worked during World War I on a break-even basis. It is located at the extreme east end of the known Pine Creek mineral belt and is on a north-south mineral fissure just opposite the strike of the remainder of the belt. The operating company now has a modern 150-ton milling plant and has opened its ore body to the 1600-foot level. During the latter development it declared $234,000 in dividends.

J. C. Kieffer, resident manager for the Spokane-Idaho Company, has this to say about the Pine Creek area: "The ore deposits characteristically have much more zinc than lead. For many years zinc was more detrimental in a lead ore than gangue because the lead smelter assessed a much higher penalty against it. . . . Because of these conditions no zinc ore was produced in the Coeur d'Alenes prior to 1905, and for many years thereafter the only zinc ores produced were from extremely rich bodies containing little lead.

"While the geology of individual properties is invariably complex and still presents unsolved problems, the area picture is now quite well known. All the ore deposits are in the Prichard formation, which is the lowest of the Belt series of pre-Cambrian sedimentary rocks which underlie the Coeur d'Alene mining district. The Prichard consists of blue shales and slates with subordinate interbedded gray sandstones and quartzites. In the Pine Creek area the formation is divided into upper, middle and lower members by reason of several massive beds of quartzite that occur within the series. The upper Prichard is 5000 to 6000 feet thick, the middle Prichard from 1800 to 3000 feet, and the thickness of the lower Prichard is not known because its base is nowhere exposed."



LITTLE PITTSBURGH AND HIGHLAND-SURPRISE

Since it was opened in 1942, the Little Pittsburgh in Denver Gulch, right, has produced more than $2,000,000 worth of ore. The milling plant of the Highland-Surprise is shown above. Its capacity was recently increased to 300 tons.

Oil Recovery by Directional Air Drive

F. R. Cozzens

AS far back as 1897, I. L. Dunn, veteran oilman of Marietta, Ohio, was nursing a theory that some means would eventually have to be found that would take the place of natural reservoir energy in producing oil fields for forcing petroleum through its host formation to well locations. Even then it was foreseen that, with the decline in gas pressure, great quantities of oil would remain underground forever unless artificial methods of recovery could be devised.

Mechanical pumping was introduced at an early date and has, through the years, retrieved millions of barrels of petroleum. However, pumps, if unaided, can at best lift only the oil that percolates through the producing formation to well bottoms. They can draw their supply from only a limited radius, especially if the rock is close-grained and of low permeability, leaving enormous quantities between wells. Dunn was thinking of some means of dislodging these deposits and moving them to well bottoms and thence to the surface. Some years later (1911), when he injected air into a Cow Run Sand well near Chesterhill, Ohio, he initiated the first commercial process for effecting what is now known as the secondary recovery of oil.

Originally patented as the Smith-Dunn or Marietta Process (patents later being revoked), its fundamental principle has been widely copied and practiced to some extent in practically every petroleum region on the globe. Through field application, thousands of barrels of oil have been and are being retrieved from wells which long ago had reached their economic limits in primary production; and in many areas, principally in the Appalachian mountain states, the output of secondary oil has far exceeded the initial flow.

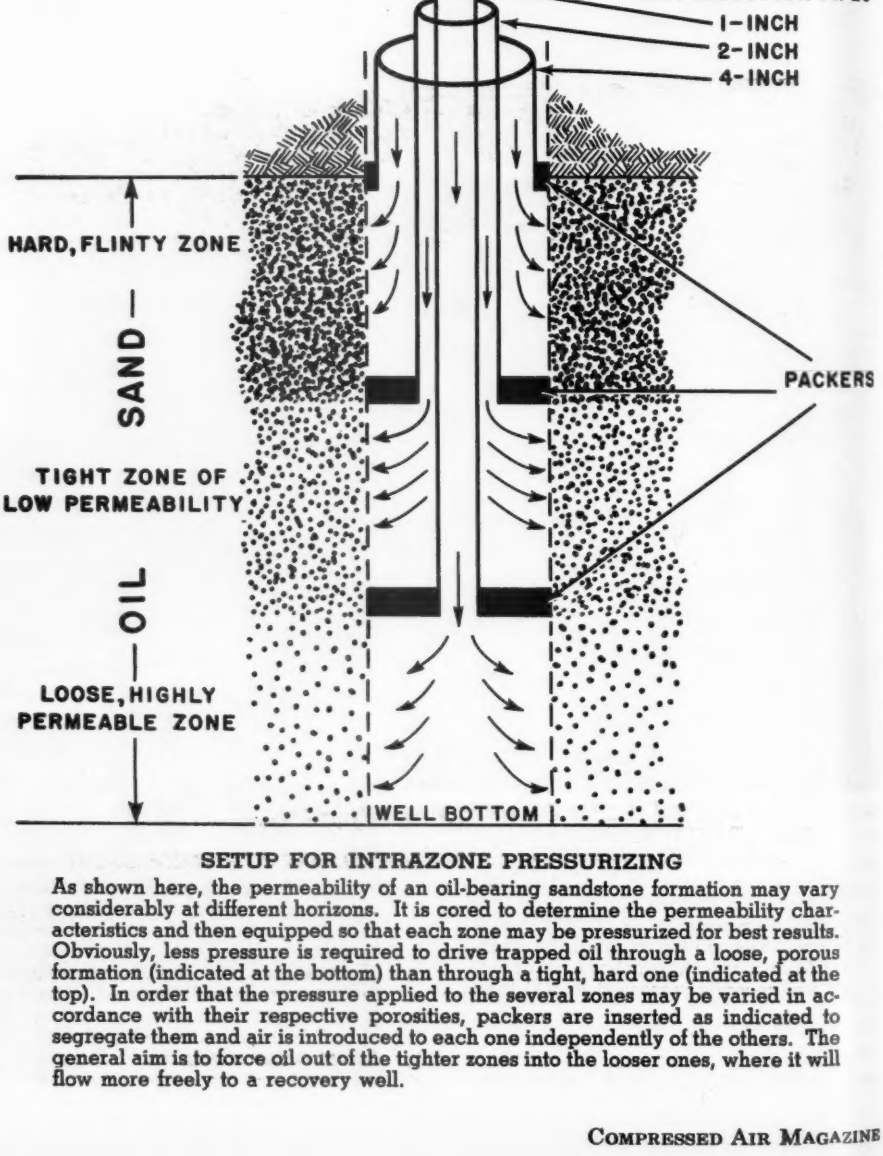
As secondary recovery is practiced today, either compressed air, natural gas, or water may be used to drive trapped oil to existing well locations. This article is concerned solely with air, which must, of course, be compressed to introduce it into the oil-bearing formation. Although single-stage machines are sometimes utilized for this purpose, 2-stage, stationary units prevail in the Appalachian fields which, being the nation's oldest, now owe much of their production to secondary methods. The compressors are usually operated by diesel engines or electric motors, although gas engine-driven machines are also used. Today, little gas comes from local formations, but it is made available by interstate pipe lines passing through such areas. The compressors are often installed in pairs, and, less frequently, up to six are stationed in one place.

While Dunn proved that oil could be forced through rock by air under pressure, he could neither predict nor control the course the fluid might take. Oil sands often have complex and complicated structures. No two are alike in physical characteristics, and no sand has a uniform degree of permeability for any great distance. Some flow courses parallel the bedding planes; others have angular trends, with frequent curves and dips. When unbridled driving energy is released in such a structure, it logically forces oil through these courses and in various directions from as well as to a receiving center.

Oil driven into inaccessible horizons of sand becomes trapped or by-passed and is invariably lost unless salvage measures are taken. So great and extensive was this wastage during the early years of repressuring (1912-1920) that air drive was on the verge of being condemned in many areas. According to tradition, Joseph Berg, an obscure pumper of Venango County, Pennsylvania, saved the situation accidentally by applying pressure controls to input wells.

Be that as it may, subsurface pressure controls soon became popular throughout the eastern oil fields and were the predominant factor in stabilizing the Smith-Dunn Process. Through such controls it is now possible to maneuver driving energy at different pressures into any zone so that a high percentage of movable oil can be forced to the pumps. This procedure is termed interzone pressuring or directional drive.

In applying directional pressures to a secondary oil reserve, the input or induction wells are not shot. The sand column is cored from top to base for the purpose of determining its physical characteristics, and wide variations in



SETUP FOR INTRAZONE PRESSURIZING

As shown here, the permeability of an oil-bearing sandstone formation may vary considerably at different horizons. It is cored to determine the permeability characteristics and then equipped so that each zone may be pressurized for best results. Obviously, less pressure is required to drive trapped oil through a loose, porous formation (indicated at the bottom) than through a tight, hard one (indicated at the top). In order that the pressure applied to the several zones may be varied in accordance with their respective porosities, packers are inserted as indicated to segregate them and air is introduced to each one independently of the others. The general aim is to force oil out of the tighter zones into the looser ones, where it will flow more freely to a recovery well.

permeability are controlled by segregating the sand bore into two to five sections. Segregation, commonly called zoning, is accomplished by setting packers at designated points along the bore so that air can be injected separately and at different pressures into each section. The packers are threaded to receive induction pipes, which are inserted down the annulus. These lines range in diameter from ½ inch to 3½ inches, and each is provided with a pressure gauge and release valve at the casing top.

After packer positions and pipe seatings along the sand bore have been checked and found accurate by steel-line measurements, the input well is connected with the compressor plant and operations are started. Air is injected slowly during the first three weeks, the zones that are lowest in permeability being given the greatest volume. Injection ratios throughout the segregated sections are followed closely, except that the volume of air fed to all zones is gradually stepped up until substantial pressure has been built up in the sand. The degree of build-up is determined at the producing wells by the flow of oil, which increases steadily until the peak is reached.

To obtain a maximum and uniform yield; it is essential that all input wells on the project be similarly processed and pressured. Inputs are spaced 200 to 500 feet apart and are generally located in the middle of a 5- or 7-spot pattern, the producing wells forming the margins. Or they may be centered in a hexagon with six producers at the corners. In a few areas this arrangement is reversed, with one producing well in the center of the pattern.

Regardless of the shape or design of the pattern, pressures are held as constant as possible until the oil output has become stabilized. When active wells nearest an input show a decline in stabilized production, then the predominant stage of interzone pressuring or directional drive is begun by reducing pressure on the porous (high-permeability) sand zones and proportionally increasing pressure on the tight or low-permeability zones. This is done to create a low-resistant area into which the oil migrates or is forced from the highly pressured horizons.

This lowering and raising of pressure proceeds gradually for five to eight weeks. Then the tactics are reversed for a similar period so as to bring about a squeezing or breathing action throughout the sand column, top to base. Since the most porous sand horizons are generally the first to be depleted, a special effort is made to maneuver the trapped oil into these zones so that ultimate recovery may be more uniform and complete. Pressures on all low-permeability zones are held high, however, until there is a substantial break-through at each producing well within a pattern.

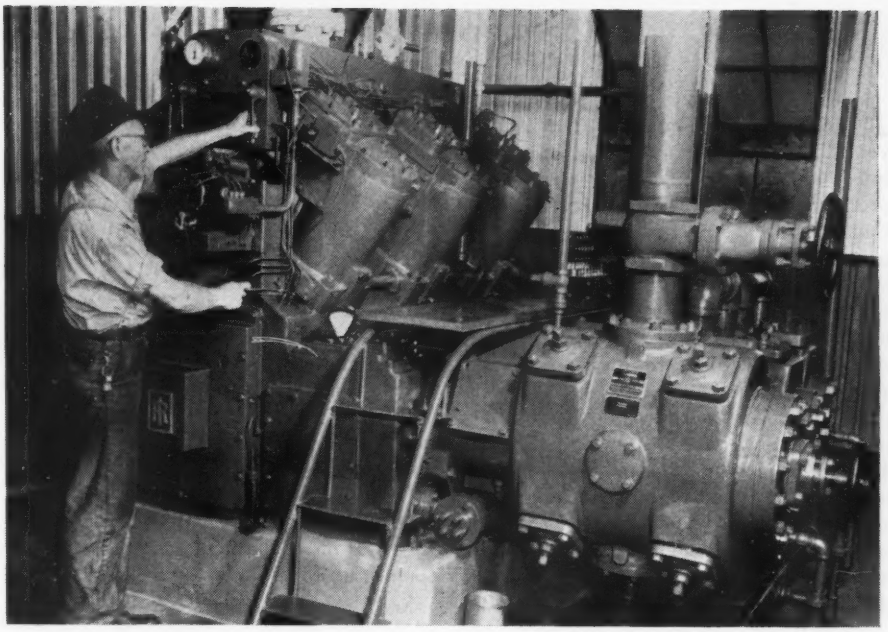
In the final stages of the cycle, the lowest sand horizons nearest the bedding planes are given the greatest volume of energy while the upper horizons are proportionately relieved. This procedure causes the fluid level to rise from the base of the sand, thus "floating" displaced oil into the receptive areas where just enough pressure is maintained to move it along to producing wells.

These basic steps of directional air drive can be and often are supplemented by sand slugging, cross pressuring, and sand splitting or fracturing. Slugging of certain segregated sand zones means applying energy in cycles; that is, pressure is applied for a 3-day period and then released for a like period, in that way inducing regurgitation or a backflow to that particular horizon. Since some water is present in all sand bodies, this alternate build-up and release of air pressure creates a so-called "Jamin action" which is frequently helpful in retrieving oil from soft, porous strata that are excessively channeled. In some areas intermittent injection is practiced extensively all through the peak stages of a production cycle and may go on for months or years.

Cross pressuring, commonly known as unbalanced drive, is generally resorted to during the final stages of secondary oil recovery and consists in releasing pressures on certain strategically located inputs for 30 to 60 days while holding pressures on surrounding inputs. At the end of that time the tactics are reversed for a like period. The purpose is to amplify within the sand body between wells the circulatory action taking place in the segregated zones of an individual input well. Cross pressuring is done mainly in areas where inputs are widely spaced in relation to producers, and is especially successful in recovering oil from sand spurs, pockets, and structural dips.

Sand splitting or fracturing of strata by air under pressure is practiced only in rare instances where an input is located in a badly conglomerated area of sand, or near the margins of an oil streak where sand layers are lensing out. Packers must be strengthened or backed up with cement to stand up under a job of this kind, and the process involves injecting air into a designated zone until sufficient energy is available to separate the sand strata and crack or fracture the surrounding rock. Pressure must be released from the well immediately after the break-through into softer horizons, otherwise the resultant channeling will cause by-passing and a waste of oil.

Sand splitting may require the continuous injection of air for 30 or more days, and the effects are comparable in many respects to those produced by light charges of nitroglycerine. Since physical conditions differ radically among oil sands, no set rule or formula for pressure induction is applicable to all cases, although a sand-face pressure of 1.5 psi. per foot of depth is ordinarily enough to cause fracturing in most strata. After the energy is released, the treated zone is washed out with salt water or brine and is then reconditioned for normal pressuring.



COMPRESSOR IN REPRESSURING SERVICE

In most parts of the Appalachian fields, gas is no longer produced from local formations and most compressors that inject air are driven by electric motors or diesel engines. However, in certain areas the availability of gas from interstate pipe lines permits using compact, flexible, and dependable gas engine-driven machines that were developed primarily for oil-field service. The unit shown is an Ingersoll-Rand Type JVG that furnishes air at pressures up to 350 psi. for secondary recovery from about 100 acres of a field on Oil Creek in Pennsylvania.

Electronic Counting of Paper Money

ALTHOUGH new paper money has been machine-counted for many years, mechanical handling of worn-out bills has until now been a perplexing problem. The money is returned to the United States Treasury in the form of packets of 100 notes cut longitudinally into half-notes. About 8 tons of currency is turned in daily for redemption. The bulk, about five million dollars' worth, consists of one dollar bills and constitutes about 80 percent of all the pieces of paper currency received for that purpose. The notes are limp, wrinkled, and difficult to handle. Occasionally, single torn bills are taped together. Their variable condition has required tedious counting by hand. The need for an effective mechanical means that would do the work both rapidly and accurately prompted the Treasury to initiate a development program at the National Bureau of Standards with that end in view.

The result is a fully automatic electronic machine that counts 30,000 notes per hour. It was designed and developed by H. M. Joseph and Carroll Stansbury of the Bureau, and the 25 units to be placed in service by the Treasury Department will effect a saving of about $250,000 annually. When the problem was put up to the Bureau, it originally turned to a transverse scanning method —similar to television scanning—across the clean-cut edges of piled and cut half-notes. It was immediately recognized, however; that the condition of the sheets resulted in irregularities and gaps between them, which made a single scan unreliable. Subsequent studies of repeated scanning showed that the ratio of the width of the thinnest gap (corresponding to one bill) to the total thickness of the pile was of such magnitude as to require resolution beyond that available with the best optical system.

These difficulties led to attempts to find ways of physically separating the sheets sufficiently to permit reliable functioning of a sensing apparatus. This was finally accomplished by clamping one end of a packet of half-notes between the opposing faces of a spindle structure and wrapping the free ends around the spindle in a roughly circular contour. The first sensing apparatus tested was a contact stylus of a vibration pickup. As each bill passed under the pen, an electrical impulse was generated and the count recorded. This system would have been useful for counting money in good condition, but there was some doubt as to its effectiveness with old and wilted currency Experimental operations involving several thousand packets of half-notes, each containing 100, indicated a high count in the case of about 5 percent of them (a positive error of about 5 parts per 10,000). The vibration pickup method was therefore abandoned in favor of the present technique.

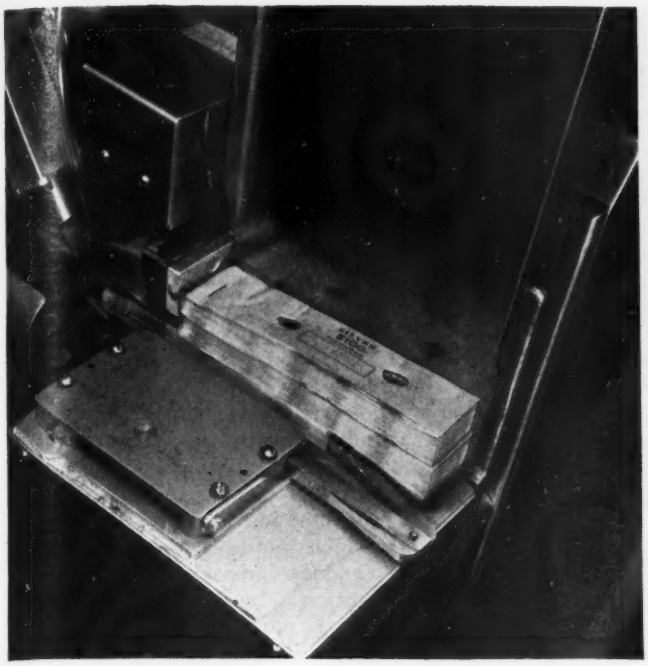
The new electronic machine is a completely self-contained unit mounted on casters and is made up of replaceable, interchangeable assemblies. It counts packets of stapled half-notes fed into an inclined trough and automatically ejects those containing 100 into an acceptance bin and those of more or less than 100 into a reject bin. Actually, in the case of the "correct packet," the counter is set for 102—hundred half-notes plus the wrapper on each side. Except for filling the trough and removing the packets, the machine operates unattended. In the event of mechanical or power failure it shuts itself off.

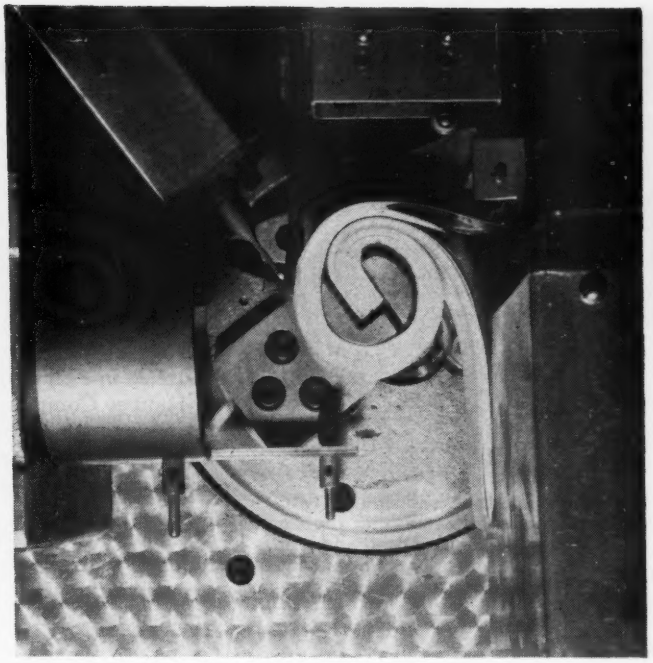
At the beginning of each cycle, a feeder mechanism or metal finger pushes the bottom packet from the trough into the machine, where the stapled end of it is gripped by metal jaws and the packet is wrapped tightly around the spindle, spreading the outer edges of the bills against a friction band. As the spindle rotates, the sheets clear the band and are separated by a jet of compressed air for counting. The jaws, which are actuated by an electrical limit switch, are then opened and the packet is cleared from the counting head by an additional revolution of the spindle, falling on a sheet-metal sorter vane which has been tilted to the "correct" or "reject" position by an electromagnet that responds to the count.

Counting is done by an electronic sensing device—a photoelectric tube and a beam of light. As the free ends of the bills are unfurled by the air stream, they interrupt the ray shining across their path, causing the phototube to function

OFFICIALS DEMONSTRATE COUNTER

Dr. E. U. Condon (left), Director of the National Bureau of Standards, is describing the action of the machine while Secretary of the Treasury John F. Snyder places packets of bills in the loading trough. The electromechanical device counts 30,000 pieces of worn currency per hour. It was designed primarily to handle one dollar certificates. Inside the cabinet is a compressor that supplies air to a jet that helps to separate the sheets so they can be counted by a phototube arrangement. Packets containing an even 100 are ejected from one of the two openings in the cabinet; those with more or less than 100 emerge from the other.





FEEDING AND COUNTING PACKETS OF BILLS

In the view at the left, the arm at the extreme right is seen pushing a packet of half-notes from the inclined feeder trough to the open jaws of a spindle (left of notes). The other picture shows the bundle locked in the jaws of the spindle and being rotated. The combined action of a friction band (curled around the outer contour of the packet) and a jet of compressed air (air hose, center) separates the sheets sufficiently so that each one breaks the light beam of a phototube (left). The resultant pulses actuate a binary counter that is set to control the sorter mechanism which rejects all packets containing more or less than 100 notes and passes the acceptable ones. Two small mirrors (one below spindle, center) reflect the light across the path of the ruffled sheets to the phototube.

and sending impulses to a binary counter. The sum of these impulses, as tallied by the latter, serves to actuate the sorting vane. In applying this technique to the worn half-notes it was necessary to observe certain critical design requirements. The light beam had to have an appreciable cross section (approximately ⅛x¼ inch) to avoid false operation by stray bits of paper and to be placed at such an angle as to be reliably deflected only by single sheets.

The mechanical details of the pusher, which holds the end of the friction band against the contour of the rolled-up half-notes, are rather critical. It was found that a knife-edged bearing offered the best solution to the problem of releasing only individual sheets. Another vital matter was the position of the air-jet nozzle relative to the end of the friction band. Its opening was placed as close as possible to the contour of the surface and set to provide a stream tangential in direction. This proved to be the only arrangement which would give the proper swinging motion to the end of each half-note as it passed the beam.

The most important factor in counting effectiveness is the condition of the money. Erroneous low counts may be attributable to various causes such as extensibility of bills due to wrinkles, folded corners which interfere with the successive release of the sheets, folded or short bills, as well as gummy mending tape or cancellation punchings with dull dies that make notes stick together.

A study of optimum spindle speeds was made to determine the effect of varying speeds on accuracy of count. The advantage of increased accuracy at low operating speeds was compared with the cost of running a greater number of machines. As a result of the findings, a speed of 15 rpm. was decided upon, but this is subject to revision upward. Since the spindles are belt-driven, change in speed is a simple matter.

In the event a packet of half-notes tangles around the spindle, a limit switch stops the automatic feed until the machine is cleared by hand. Other limit switches bring the electronic counter to a standstill when it runs out of packets by interlocking the motion of the turntable on top of the unit, which carries the jaws, and that of the feeder mechanism. The device is said to be "fail-safe" in the sense that a large percentage of possible equipment failures are such as to cause all packets to be rejected. Attendants would quickly notice that and take the particular machine out of service. The same thing would happen if all packets were ejected into the acceptance bin.

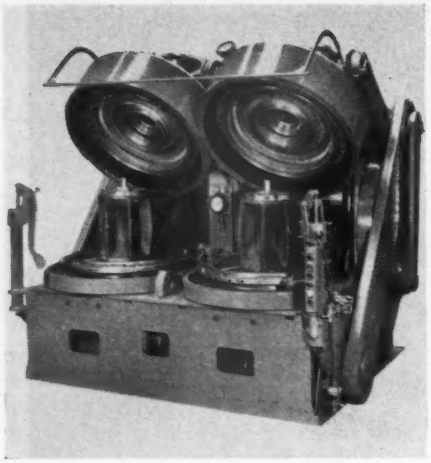
No Danger of an Oxygen Shortage for Humans

ACCORDING to Baldwin's book on heating, an adult inhales about 415 cubic centimeters of air with each breath, and when he exhales it the oxgyen has been consumed. At an average rate of fourteen respirations per minute, that amounts to 300 cubic feet of air, or about 25 pounds, a day. In round numbers, there are two billion people on the earth. Assuming, to avoid complications, that all are adults, they would have to have 18,250,000,000,000 pounds of air annually.

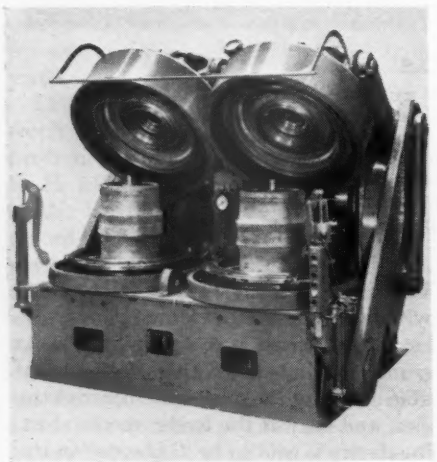
More figuring indicates that all the fuel—coal, wood, oil, and gas—burned each year is equivalent to 2200 million tons of coal. To support combustion, a pound of coal needs about 15 pounds of air, which means an annual requirement of 66 trillion pounds, or about 3.6 times as much as that for human respiration. Adding the two, we arrive at 84,250 billion pounds.

Over every square inch of the earth's surface there are approximately 14.7 pounds of air. To compute the total weight of the atmosphere, we determine the number of square inches of the earth's surface and multiply that figure by 14.7. The answer is 11,850 followed by fifteen ciphers—in other words, 11,850 quadrillion pounds. Dividing that figure by 84,250 billion, we find that, at the present rate of consumption, our atmosphere contains enough oxygen to last 141,000 years. Fortunately for our descendants, the earth's vegetation is just as busily engaged in replenishing the oxygen supply as we are in depleting it. However, even without that assistance, it is apparent that we haven't much to worry about.

One Machine Does the Work of Three



At the starting stage, showing the twin-dome Bag-O-Matic press with the upper halves of the molds raised and with the curing bladders fully collapsed and in the down position for loading.



Here the machine is pictured with the green tires in place ready to be closed. Low-pressure steam is admitted into the bladders which, upon expanding, press the carcasses against the molds.

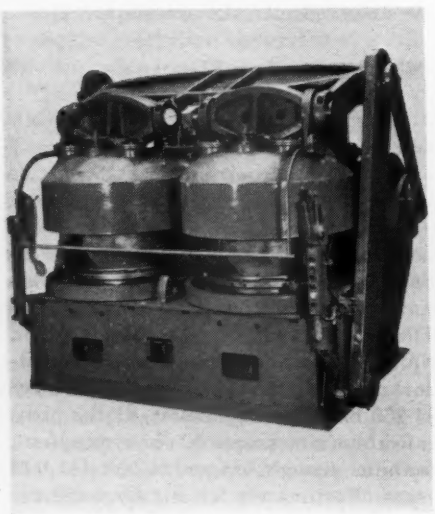
SHAPING and vulcanizing passenger-car tires by the conventional curing-bag method seems to be on the way out, judging by reports on a press that has been brought to a practical stage within a span of about five years by The McNeil Machine & Engineering Company, specialists in equipment of this kind. Called the Bag-O-Matic, the first unit built was installed in a plant of the Goodyear Tire & Rubber Company on an experimental basis in 1949, with the result that most tire manufacturers are today gradually substituting the new for the old equipment.

Under ordinary conditions the work requires the services of three machines: a pneumatic press that takes a green drum-shaped carcass and gives it the desired form. Next, after an air bag has been pushed into the tire, the latter is transferred to a vulcanizer in which it remains anywhere from 35 to 45 minutes. At the end of the curing period it goes to a machine provided with iron jaws which grip the bag and pull it out of the cured tire. The new press performs all these operations progressively with no rehandling of the work from the time a carcass is put in place until the finished tire is removed.

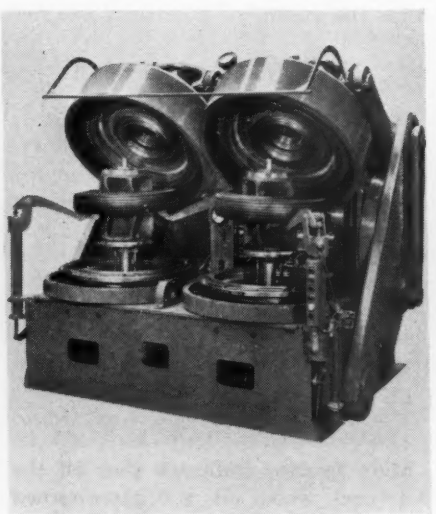
Although the Bag-O-Matic is complex in construction, there is nothing complicated about the way it functions. The machine, as the accompanying sequence pictures show, is of the twin type. It features a new kind of curing bag or bladder which is independent of and positioned vertically in the mold. At the start of operations, it is fully collapsed by drawing a vacuum on it so the green tire can be slipped over it with ease. With both units loaded, the hinged dome is lowered by pressing a push button, and by the time the machine is closed the two tires are formed. This is generally accomplished by admitting low-pressure steam into the bladders.

The next step in the cycle is vulcanizing. This is done by high-pressure steam or hot water which, as in the case of the low-pressure steam, is introduced automatically through the medium of an electropneumatic timing mechanism and air-controlled diaphragm valves. Curing is effected in from 20 to 25 minutes, after which the internal pressure is released and the domes rise without human intervention. In doing so, the upper halves of the molds are stripped from the tires, leaving the latter in the grip of the lower halves.

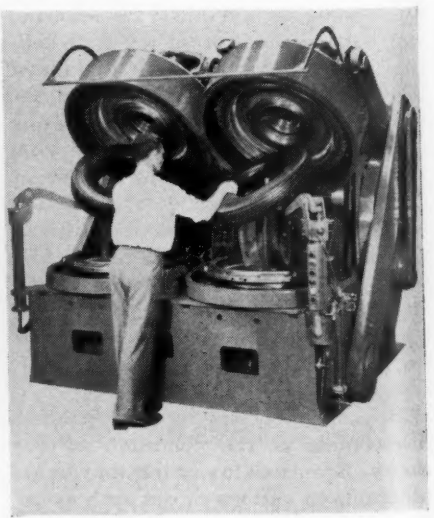
Stripping is completed by the aid of a large metal ring fastened to and projecting slightly beyond the base plate of the curing bag, which is moved up and down by a vertical air cylinder in the lower part of the machine. With the upstroke of the cylinder piston, the ring strips the tire from the bottom mold, and then two arms, which come into action automatically, raise it to a predetermined point and hold it there. The lifting arms also are controlled by pneumatic cylinders. By pushing a hand valve, the bladder, with its twin, is then returned to the "down" position, enabling the operator to remove the finished tires and to start another round by pulling a vacuum on the bags to insure their complete collapse and by reloading the press with green carcasses.



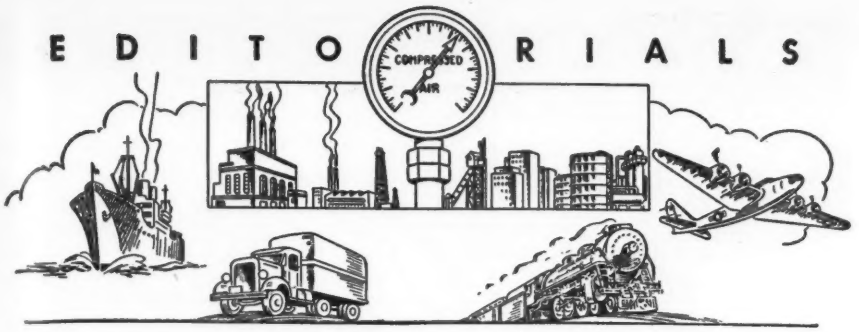
Gradually, as the domes descend, the tires take form, as shown here. By the time they reach the end of their travel molding is finished. The press remains closed during vulcanization, which follows.



Stripped from the molds, the finished tires are held up by lifting arms preparatory to removal. The arms and the curing bags are raised and lowered by means of pneumatic cylinders, one of which is seen at the left.



With the bladders lowered and reduced to the smallest possible diameter by pulling a vacuum on them, the tires are quickly removed. The complete curing cycle for most passenger-car tire sizes is only twenty minutes.



DRILLING INDUSTRY NEEDS TUNGSTEN CARBIDE

IN TIMES like these there is a big scramble for scarce materials. Some, such as strategic metals and minerals, must be brought under government control, and the problem of allocating them so that they will do the most good for the defense effort and cause the least possible hardship to civilian consumers is not easy to resolve. Most applicants are bound to get less than they want, and there is even danger that some who merit a plentiful supply will be deprived unless the pertinent facts are presented so clearly that they cannot be misunderstood.

Manufacturers of rock-drilling and coal-cutting machinery are currently submitting their requests for liberal allocations of tungsten carbide to the authorities at Washington. This modern miracle metal ranks next to the diamond in hardness and has so many valuable uses in a war economy that any nation lacking it would have small chance of winning a conflict against an adversary possessing it. About 70 percent of our supply of its essential component, tungsten, ordinarily comes from China and Korea, and the shutting off of those sources has intensified its scarcity.

A few ounces of shaped tungsten carbide inserted in a drill bit to form cutting edges will phenomenally increase the bit's capacity to put blast holes in rock or mineral. Such a bit will drill holes 50 percent faster than the best obtainable steel bit and produce from 100 to 400 times the footage before it is worn out. In effect, it approximately doubles the work a driller can do each shift. This obviously saves manpower and greatly increases the productive capacity of mines that turn out iron, copper, zinc, lead, and other strategic minerals.

Aside from direct gains in drilling efficiency, tungsten-carbide insert bits effect additional indirect savings. In the case of conventional steel bits, dulling necessitates a change after a few feet of drilling and the use of a smaller bit with each change to compensate for the reduction in gauge of its predecessor through wear. Thus, in order to bottom a hole at a given diameter, the starting diameter must be considerably larger. In contrast, a single carbide-insert bit will drill a deep hole, or even several of them, without appreciably losing gauge, and smaller bits can consequently be utilized.

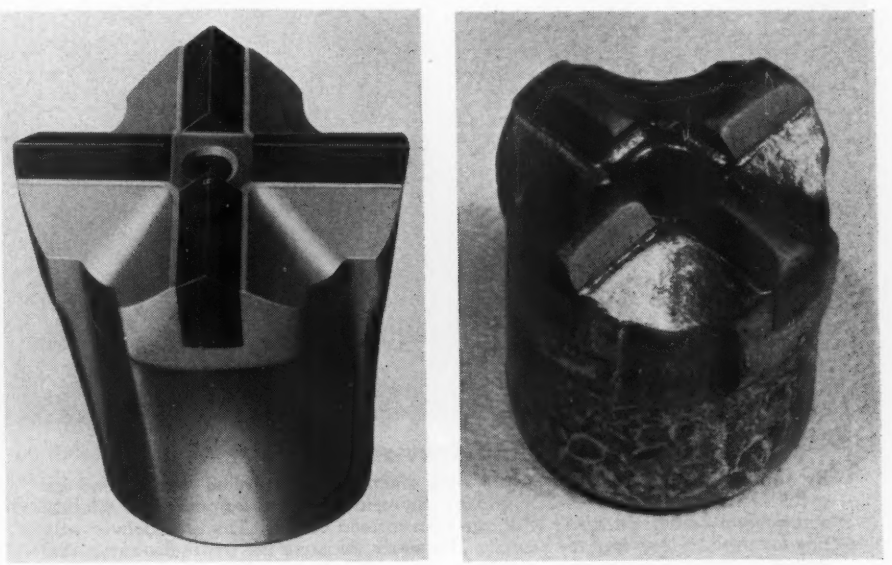
This permits using lighter drills than are required for steel bits, reduces the consumption of compressed air per drill (with attendant savings in power), and cuts the need of dynamite for blasting by as much as 30 percent. Moreover, because the drill is doing twice the amount of work as when steel bits are employed, the cost of replacement parts and labor decline by as much as 50 percent when figured on the basis of footage drilled.

In addition to these advantages, emphasis is placed on the fact that steel can be conserved if the industries concerned are assured an adequate supply of carbide-insert bits. Two types of steel bits are in current use: the throwaway, which is discarded after serving once; and the multiple-use kind, which is resharpened from five to seven times before it is discarded. At present, tungsten-carbide bits utilized for drilling other than in coal mines require about 1,500,000 pounds of steel annually. If throwaway bits were substituted for all of them, calculations show that the demand for steel for bits alone would jump to 40,000,000 pounds, plus 6,000,000 pounds for drill rods. If multiple-use bits replaced all the carbide-insert bits the steel requirement would be 20,000,000 pounds. While equivalent data for the coal-mining industry have not yet been assembled, it is believed that the same ratio would apply, in which case the discontinuance of the use of tungsten carbide in cutting tools would increase steel consumption by at least 20,000,000 pounds a year.

The manufacturers' presentation is based on current rates of ore and coal production. As mineral output is on the rise, and the trend will undoubtedly persist, the benefits that can be expected to accrue by continuing to supply the industries involved with ample tungsten carbide will grow in proportion. The present annual demand for tungsten carbide for rock-drill bits is approximately 160,000 pounds.

Canada, which furnishes us with large quantities of strategic minerals, has the same allocation problem. With an insignificant yield of tungsten, our northern neighbor is dependent upon us for her carbide supply. However, she is expanding her defense production facilities on such a vast scale that the faster drilling of rock and ore becomes increasingly important. Indicative of this is the fact that one drill manufacturer is making as many carbide-insert bits for the rock-excavation work of a single huge new aluminum development in British Columbia as he normally sells to all Dominion users in a year.

All in all, it would seem to be sound common sense to provide the drilling industries with sufficient quantities of precious tungsten carbide to meet their full needs.



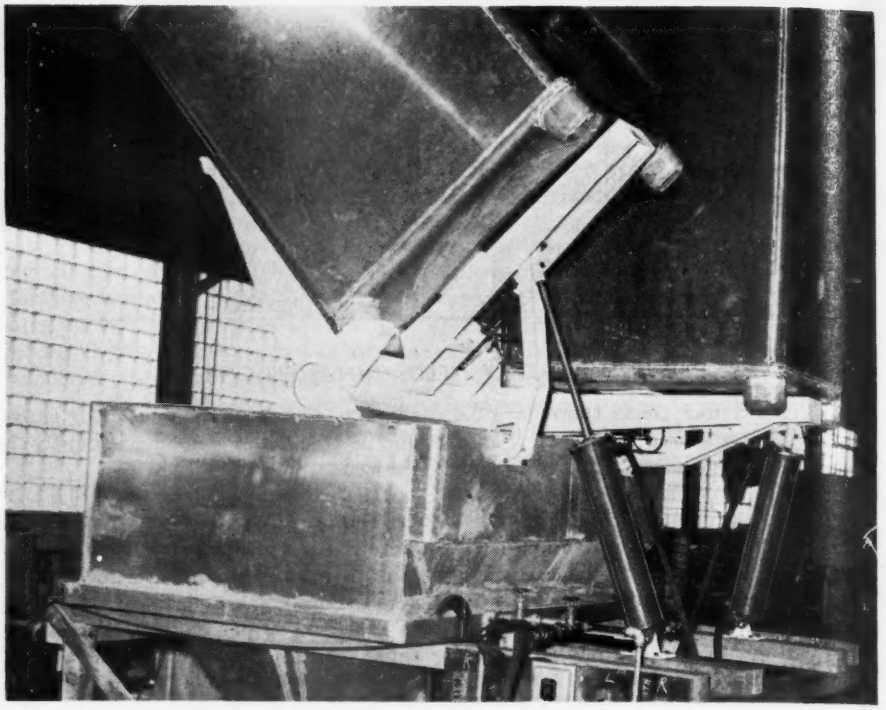
KEY TO MINING ECONOMY

A new Carset (tungsten-carbide-insert) bit and one that has drilled 335 feet of hole in granite. Time, manpower, and steel can be conserved in mining strategic metals if bit manufacturers are assured an adequate supply of tungsten carbide.

Portable Bin Facilitates Handling Bulk Material

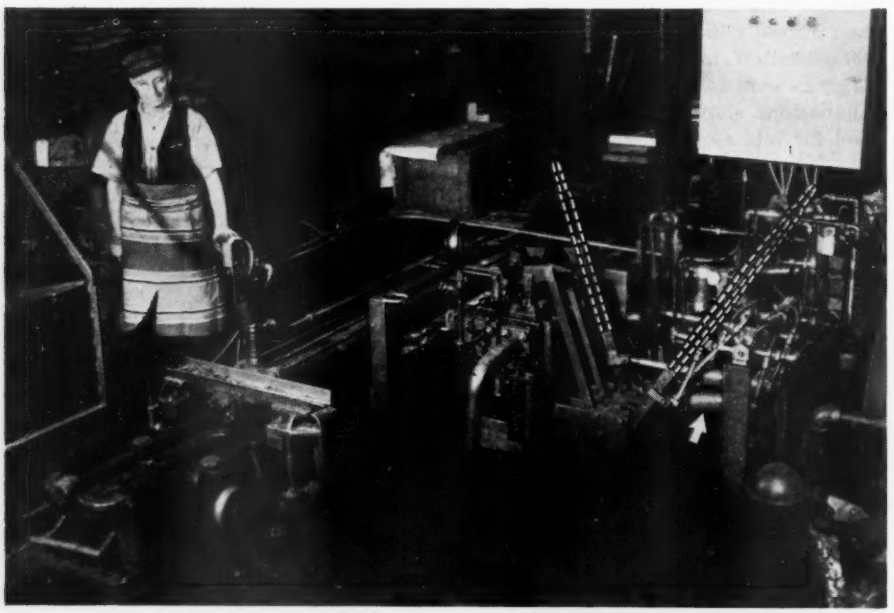
STORING, handling, and shipping dry bulk materials such as sugar, flour, salt, powdered milk, cornstarch, soap, etc., has undergone a change through the introduction by Tote System, Inc., of aluminum bins that take the place of the familiar bags and other destructible containers. The standard unit measures 42x48x68 5/8 inches and has a volume of 74 cubic feet. The material enters by way of a top opening closed by a rubber-gasketed 9-inch lid and discharges at the bottom through a 36x16-inch hinged side door with a molded rubber packing and a latching mechanism. The contents are at all times protected against contamination and spillage, while wires and seals, affixed on both lid and door, prevent tampering in transit. As many as eighteen of these bins have been transported by truck, and a 50-foot rail car accommodates 28.

The containers are of sturdy construction to permit high piling with fork lifts or pallet trucks. They are part of what is called the Tote System for in-plant and inter-plant service. It includes a jolter and a "spinner" head to compact the material and fill the bins to capacity, as well as a special rack that tilts each in turn 45° for unloading. The latter is equipped with a screw or other type of discharge and with a vibrator to facilitate emptying. Where speed of operation is essential, tipping is done by a pneumatic cylinder. The accompanying illustration shows an installation of this kind with two Tote bins dumping into a receiving hopper. While one is being unloaded, another full container is being substituted for an empty.



IN A SOAP FACTORY

This picture shows two Tote bins on tilt racks, one in the dumping and the other in the down position. The racks are mounted on top of a receiving hopper and the containers are delivering dry material that was stored in them until it was needed for packaging. Each has a capacity of 3000-4000 pounds. The tilting units are of the gravity-discharge type and are operated by pneumatic cylinders using air at 80 psi.



AIR POWER CONSERVES MAN POWER

By replacing hand-operated levers with electrically controlled compressed-air cylinders, The Riverside Metal Company, Riverside, N. J., now operates each of its scrap-metal baling machines with one man instead of two. The changeover will pay for itself in less than ten months. Formerly, to move the hydraulic rams, the dotted-in levers in the picture had to be manipulated manually. One worker was required to do this and a second was stationed at the loading zone. Now, remote-controlled pneumatic cylinders (arrow) enable one man (hand on controls) to load, operate, and unload the machine. The change has more than doubled the bale output per man-hour and released workers for other duties at a time when defense production at the plant makes labor conservation highly important.

Will United States Adopt Metric System?

MANY persons think that the United States will inevitably adopt the metric system of weights and measurements. We and Great Britain are the only important nations that do not now use it. The change would cause great inconvenience and expense, but the longer the step is deferred the greater these unfavorable factors become.

Many of us are not aware of the fact that James Watt, the English engineer of steam-engine fame, originated the decimal system, which has generally been attributed to the French or Germans. Nor is it well known that the system used in Great Britain and America is of German origin. We therefore have the anomalous situation of English-speaking people clinging to a German invention, which the Germans themselves have dropped, while the rest of the world has adopted an English invention.

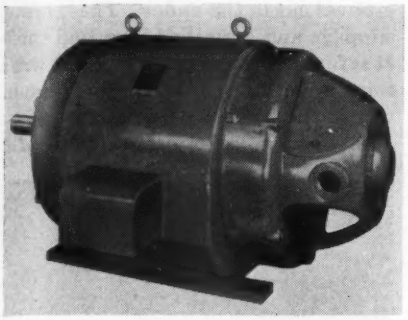
Here is a simple tabulation that makes it easy to remember the approximate relationships between representative units of the two systems:

ENGLISH	METRIC
Length - 1 yard	plus 10% = 1 meter
Weight - 2 pounds	plus 10% = 1 kilogram
Volume - 1 quart	plus 5% = 1 liter

Industrial Notes

According to *General Electric Review*, a new type of hose has been developed for pneumatic boiler controls. The air used to actuate them is fed through seven small tubes bound together to form a single "cable."

Pictured is a 200-hp., 1750-rpm. heavy-duty, wound-rotor induction motor, one of a new line announced by the Electric Machinery Manufacturing Company. Built in ratings from 30 to 1500 hp., the units are sources of flexible power, being suitable for use requiring either



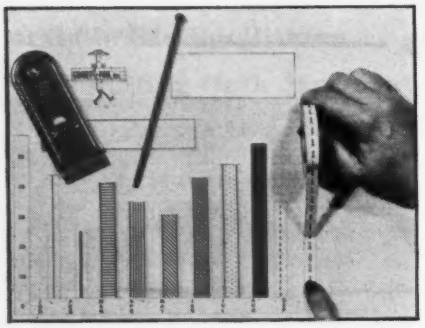
variable-speed drive or high starting torque and low starting current. The standard type is of drip-proof construction, but enclosed—splash-proof—units with forced ventilation are available. The motors are furnished with ball- or split-sleeve bearings, and are readily accessible for inspection and maintenance. A ratchet-wheel tension adjuster provides for metered step-by-step increase or decrease of pressure on the individual brushes, which are reached for cleaning by removing cover plates with fingertips.

As the result of routine testing, Westinghouse scientists in coöperation with Crane Company have discovered a process that is said to double the hardness of stainless steel. One in a batch of samples was found to have a magnetic effect after being handled in a certain way at minus 300°F. Upon further investigation it was proved that rolling at the lowest temperatures gives the metal the greatest hardness and highest strength values. The process is called Zerolling.

In place of the familiar poured-lead bushings, Norton Company is producing precision bushings for grinding wheels, according to a recent announcement. The new patented bushings are light in weight, of uniform size, and are pressed into the wheels. These features are said to preserve the inherent balance of the wheels; to maintain hole sizes and, therefore, mounting conditions; and to insure more than normal holding power. At

present Norton is making them for straight wheels from 5 to 8 inches in diameter, but as soon as manufacturing facilities can be expanded wheels of other shapes and sizes so equipped will be available.

Much of the drudgery in drafting is eliminated, it is claimed, by the use of Chart-Pak, prefabricated materials in the form of plastic board with grid lines in nonphotographic blue, rolls of tape for bars to show comparisons, and rectangular boxes in twelve sizes for organization and flow-process charts. Both tape and rectangles are gummed for ease of application and removal and come in a kit with a knife and cleaner. Completed



charts can be photo-offset or photostated for future reference and the tapes peeled off the board to receive new ones. The new method and materials were developed by Chart-Pak, Inc., of Stamford, Conn.

To control and indicate the rate of flow of relatively small volumes of gas or air, King Engineering Corporation has introduced a new sight-feed bubbler. The cylinder is of Pyrex or plastic, depending upon pressure requirements, and all units are factory tested at 100 psi. and more. Inlets and outlets at the sides and rear give a choice of four piping connections. The dip tube is set off center and the bottom end is cut at an angle so that the bubbles all rise near the middle where they are easily observed. The rate of flow can be adjusted by a needle valve at the top to a maximum of 20 cfh. Typical uses include bleeding air into lines to purge them of corrosive fumes and, in combination with hydrostatic liquid-level gauges, to control and register the flow of compressed air required for continuous gauging. A drain plug at the bottom permits the removal of excess liquid resulting from condensation of moisture in the gas or air.

Twelve years of research by the United States Rubber Company has produced a rubber-and-fabric belt that is considered a milestone in power transmission. Its distinguishing feature are rubber teeth, which are regularly spaced along the inner surface and engage corresponding grooves cut in the pulley. These prevent slippage and permit split-second timing. It is further claimed that the belt will attain speeds up to 16,000 feet per minute; will run on fixed centers without take-up adjustments; requires no lubrication;

operates more quietly than precision gears running in an oil bath; and, because of its extreme flexibility, permits the use of pulley diameters as small as ½ inch at 10,000 rpm. even with a heavy load. Known as the Gilmer Timing Belt, it is now in large-scale production limited for the present to specifically engineered applications, which already cover a wide range. However, the company expects to offer a standardized line of stock drives in light- and heavy-duty construction with pulleys to give an adequate range of speed ratios (speed ratios up to 30:1 are possible).

Spraying of all kinds of heavy industrial materials such as roofing and calking compounds, sound absorbers, adhesives, and gummy mastics is done without spurting, it is claimed, by means of a new high-volume Powerflo Pump of the Mogul type announced by Gray Company, Inc. It is equipped with a device called Evenflo, which prevents the objectionable blobs on surfaces often caused by spray guns. The pump is powered by an air motor and delivers the material direct from 400- or 100-pound

drums or bucket-type containers through hose connections, thus eliminating messy time-wasting transfer. Moguls are operated with air at from 20 to 175 psi. and are easily serviced.

For use where underground piping is to be protected against corrosion by the anodic method, Apex Smelting Company is offering a convenient magnesium anode. It is packed in a permeable-cloth sack with a chemically balanced backfill that is said to insure the longest possible service life. A 10-foot length of insulated copper wire is attached to each unit, which is placed in a specially prepared shipping carton. Called Anode-Pak, two sizes—17 and 32 pounds—are available.

General Electric's alternating-current, adjustable-speed motor is now obtainable with a preset-speed device—a simple mechanism mounted on the motor by which the operator can regulate the speed as desired by a knob either on the unit or 10 to 15 feet away at the end of a flexible cable. He can do this with the motor running or standing still. In the case of the ACA, speed control is effected by brushes rotating around the commutator. This is taken advantage of in the new device, which has a pilot motor that drives the brushes to a point corresponding to the adjustment-knob setting. The latter is not disturbed when the brushes are returned to the lowest speed position by an automatic stop or slow-down. When the ACA is restarted, the brushes again take the preselected-speed position without any attention from the operator.

Under the name of Airfuge, The Swartwout Company has announced a complete line of separators for cleaning compressed air. It is of the centrifugal type and is said to remove 99 percent and more of all impurities in the air without a drop in pressure. Entrained moisture, oil, scale, and other solids are whirled against the walls of the unit, whence they drain down into a float-operated trap that automatically releases the accumulated liquid when it rises to a level above that necessary to effect a seal. The drain-valve outlet is tapered to prevent stoppage. The Airfuge is available in seven inlet and outlet tapping sizes ranging from ½ inch to 2½ inches.

For the protection of wood patterns for foundry molds, Carboline Company is marketing a coating that is said to last four times as long as conventional products. Reports of laboratory tests indicate that its hardness is only 10 to 15 points lower than that of steel, so that it is often possible to use hardwood instead of softwood. It is further claimed that patterns so treated are highly resistant to dry rot and that the wood retains its moisture content and does not weather. The coating withstands temperatures up to 350°F.

Siliphane, a transparent silicone product, is a new water repellent for exterior masonry walls above ground level. The preparation is applied by brushing or spraying and is said to penetrate deeply, covering the surfaces with a microscopically thin film but not closing the pores. It was developed jointly by Prima Products, Inc., and the Linde Division of Union Carbide & Carbon Corporation.

There is a new degreasing system on the market for differentials, transmissions, and overdrives of automobiles, trucks, and tractors that features a port-

"Aw, what are you worried about, Harry? That rope is guaranteed, you get another one for nothing."

able heat gun using a highly vaporable liquid solvent. It is claimed that the hot vapor fogs everything in the gear case, dissolving all grease and draining off spent lube, gummy residues, corrosive acids, and abrasive particles. It is made by the Vokar Corporation, which recommends the use of its Dee Tee System twice a year, or every 10,000 miles.

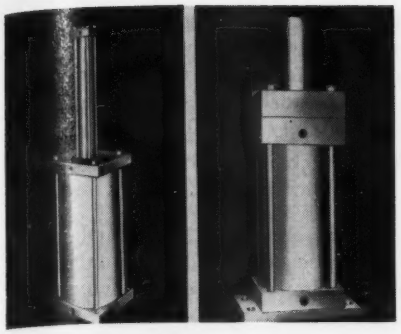
Lovejoy Flexible Coupling Company has announced a tilting base that is adjustable in length and width to accommodate all sizes and types of fractional horsepower motors. Tilting is controlled by a screw and, by changing the position of the motor, adjusts belt tension or output speed if a variable-pitch sheave is used. The unit measures only 5½x7 inches.

Low-pressure-air accumulators that "store" fluids at high pressures for use when required and eliminate the danger incident to handling high-pressure gases are being offered by the Miller Motor Company. Plant air at 60 to 200 psi. serves as the compressible medium. During the nondemand cycle, oil flows into the accumulator and, under high pump pressure, acts upon a hydraulic piston driving a larger air piston which, in turn, acts upon the compressible medium. The oil is thus stored at pressures up to 10,000 psi. for immediate or later discharge usually at high flow rates of short duration such as are needed for die-casting machines, plastic molding presses, and heavy machine tools. Because of their all-metal construction, the accumulators are suitable for service where severe shock loads are encountered, especially where they must completely unload themselves in stopping a moving mass and reversing the motion. They can also be used to advantage for loading hy-

---

PROTECTS YOUR CAR

Designed primarily for the use of auto mechanics, the cover shown prevents finishes and upholstery from being damaged while cars are undergoing repairs or servicing. Made of Goodyear Vinylfilm by Industrial Covers Company, the weather- and waterproof cloth is available in sizes 36x54 and 36x66 inches and has numerous other applications also in the home.



ADAPTABLE ACCUMULATORS
Two of a wide range of models for "storing" oil under high pressures for varied services. Left and right, the units are designed to develop up to 3000 and 10,000 psi., respectively.

draulic die cushions or for other non-pumping applications and, by changing their circuit connections, can be converted into boosters with either plant oil or air-line pressure serving as the input medium in developing a maximum hydraulic output pressure of 10,000 psi. for operating hydraulic work cylinders. The units are built up from standard Miller air- and hydraulic-cylinder components in a variety of sizes and mounting styles.

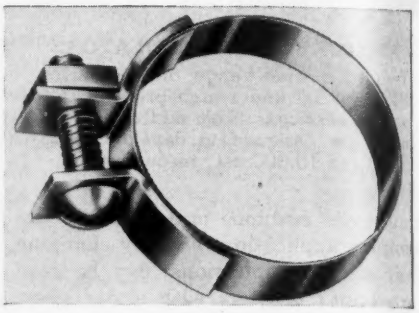
What is described as an electrically conductive floor resurfacer is offered by Rock-Tred Corporation for use in plants handling and processing materials such as mercury fulminate, tracer mixtures, igniter compositions, and black powder. Named Condurock, it can be applied to concrete, metal, brick, wood, or composition flooring to minimize the hazard of explosions due to static electricity.

For industrial application where air must be circulated in opposing directions there is now available a fully reversible fan. A product of Hartzell Propeller Fan Company, the unit is 36 inches in diameter and features a propeller of new

"I hate to tell him that he's disqualified."

design that it has taken the concern years to develop. Operated by a 2-hp. motor, the fan can be reversed manually or automatically and is said to deliver approximately 20,000 cfm. of free air either way.

Band, ears, nut, and bolt of the new hose clamp shown are all of stainless steel to prevent corrosion. It is manufactured by Specialty Products Company and is



available in six standard sizes from ½ inch to 2 inches. The company also designs clamps of this type to meet special needs.

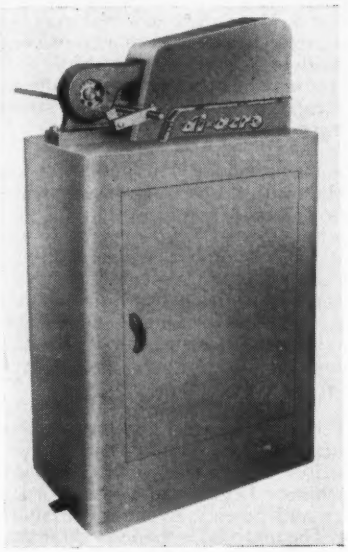
One part of a new additive in 1200 parts of cutting oil will keep the latter in condition throughout its useful life. According to the West Disinfecting Company, which compounds the preservative, it's a preventive against rancidity and odor, inhibits the growth of bacteria, stabilizes the emulsion, and enables the coolant to retain its lubricating qualities. Where sanitary codes are in force to regulate the disposal of spent cutting oil in public sewers or streams, the additive is said to maintain the minimum permissible bacteria count.

For the comfort of the operators, the American Hoist & Derrick Company is now providing its new diesel-electric cranes with a ¼-inch-thick eye shield made of a sheet of green Plexiglas. The front end of the roof of the cab is built of this strong plastic material, which insures the man at the controls full visibility and enables him to watch the movements of the boom without eyestrain due to glare.

To help prevent the spread of athlete's foot in public places, Waverly Petroleum Products Company has designed a new type of spray dispenser, together with a

sanitary solution that contains the latest acceptable ingredients for the control of the fungi. Known respectively as Sani-Mister and Sani-Mist, the former consists of a treadle mechanism and hydraulic pumps which are actuated by the user by a treading motion. A fine vapor is thus sprayed through aluminum grillwork, covering the feet and ankles and penetrating between the toes. Each application, which takes but three seconds, is fresh and undiluted and there is no chance of reinfection, it is claimed.

Speed of operation and cutting without distortion are advantages claimed by O'Neil-Irwin Manufacturing Company for its new Di-Acro Power Parter for rods and bars of varying sizes. The machine is actuated by an air cylinder cushioned at both ends for quiet functioning. Air at 80 psi. pressure is used, and control is effected by a 4-way foot valve leaving the operator's hands free to handle and advance the stock. A cutting head with ten holes ranging in diameter from 1/16



to 5/8 inch in steps of 1/16 inch is standard; others to accommodate rods and bars of special sizes and shapes are available. All are reversible to give double service and are easily removed. Production is stepped up by means of an Ejectomatic Gauge that makes it possible to do the work of gauging, parting, and ejecting in one cycle.

It's a tough job to dig post holes by hand when the ground is frozen hard, and for that reason putting up billboards in northern regions is sometimes a seasonal job. But that is no longer the case with one enterprising outdoor advertising concern in Milwaukee, Wis. It has equipped itself with a mobile unit mounting a compressor and carrying a pneumatic spade, auger, drill, and tamper. With these tools a 2-man crew can do the work without physical effort and excavate sixteen holes for a 2-panel signboard in less than three hours.

Books and Industrial Literature

The term aluminum now applies to a large family of metal alloys, each with its own peculiar properties. To make an intelligent selection, the user must have specific information as to tempers, sizes, shapes; physical, chemical, and mechanical properties; as well as fabricating characteristics of each one. These facts have been condensed into a pocket-size manual of 194 pages which contains 117 tables, that give essential data at a glance, and 61 illustrations of operations required in the production of aluminum. The book, an enlargement of a previous edition, may be obtained without cost by engineers, designers, and technical men who request it on a company letterhead from Reynolds Metals Company, 2500 South Third Street, Louisville, Ky.

A complete line of apparatus for use in conducting soil tests is described in Catalogue 3-51 distributed by Soil Testing Services, Inc., 4520 W.North Avenue, Chicago 39, Ill.

Hastings Instrument Company, Hampton, Va., offers a leaflet describing its Model G air meter suitable for measuring the rate of flow in gas and air systems and for determining wind velocities.

Catalogue 1B-1 published by Barksdale Valves describes Shear-Seal valves of shut-off, selector, and manipulator types for use in air or water systems at pressures up to 6000 psi. It includes data for determining the appropriate valve to meet a given set of service conditions.

Steam specialties such as steam and air traps, pressure-reducing valves, pump governors, pressure regulators, boiler-feed controls, and temperature regulators are covered in a bulletin issued by The C. E. Squires Company, 18502 Syracuse Avenue, Cleveland 10, Ohio.

Hydraulic cylinders manufactured by Hanna Engineering Works, 201 North Wells Street, Chicago 6, Ill., are described and illustrated in a 28-page catalogue, No. 233-A. Suggestions for using the cylinders to obtain various mechanical movements are also included.

Merely pressing hand grips on the side of a new design of the Ernst Portable Tester gives a direct reading of the hardness of any type of metal. It is described and illustrated in Bulletin ET-44 obtainable from Newage International, Inc., 521 Fifth Avenue, New York 17, N. Y.

Couplings for hose lines carrying various kinds of fluids are described and illustrated in a catalogue prepared by The Hansen Manufacturing Company, 4031 W. 150th Street, Cleveland 11, Ohio. The appliances are designed for lines handling air, oxygen, acetylene, steam, gasoline, and other gases or liquids.

Four designs of Tri-Clad high-speed synchronous generators are described in a 4-page bulletin, No. GEA-5470, obtainable from General Electric Company, Schenectady 5, N. Y. The generators are for standby, portable, and prime-source power services in the range from 1.875 to 50 kva., with frequences of 60 and 400 cycles.

Johns-Manville has developed the first insulating fire brick for sustained service at temperatures up to 3000°F. It is designed for use in forge furnaces, ceramic kilns, chemical-process furnaces and the like. Called the JM-3000, it is described in a folder obtainable from the company at 22 E. 40th Street, New York 16, N. Y.

A steel box that can be quickly dismantled or reassembled has been developed by Jervis B. Webb Company, 8933 Alpine Avenue, Detroit 4, Mich., for handling industrial materials. Four freight-car loads of filled boxes can, after being delivered and emptied, be knocked down and returned in one freight car. An illustrated descriptive folder is available on request.

Mine Safety Appliances Company, Pittsburgh 8, Pa., offers a 4-page bulletin, No. CH-2, describing its Pneolator, which makes possible artificial respiration without suction. The apparatus automatically inflates the lungs of an unconscious person with oxygen in the right amount and at the proper pressure. Exhalation is taken care of by the normal contracting action of the lung muscles.

A power shear for cutting various materials ranging from paper through plastics and laminates to light metals is described in a folder obtainable from Hobbs Manufacturing Company, 26 Salisbury Street, Worcester 5, Mass. The material may be fed to the cutter as sheets from a conveyor, table, or skid, or from single or multiple rolls. The cutter may be operated continually or intermittently at speeds up to 70 strokes per minute.

Some previously unpublished material dealing with the cleaning of coal by the sink-float process is contained in a 36-page publication, *Heavy-Media Separation Processes for Coal Preparation*. A general discussion of the subject is supplemented by descriptions of seven separation plants, including 20 illustrations and flow sheets. Obtainable from the Mineral Dressing Division, Amerian Cyanamid Company, 30 Rockefeller Plaza, New York 20, N. Y.

Tri-Lok open steel flooring, which is constructed without rivets, bolts, or welds, is described in Bulletin No. 1103, issued by the Machinery Division of Dravo Corporation, Fifth and Liberty Avenues, Pittsburgh 22, Pa. The material is made in three patterns, all of which provide 90 percent open space. Related products are steps and armoring for concrete flooring. The bulletin includes specifications, safe load tables, and installation instructions.

Staynew filters for the extraction of moisture, oil, and solids of various kinds from compressed air or gas are covered in a new bulletin, No.B-1A, offered by Dollinger Corporation, 11 Centre Park, Rochester 3, N. Y. Specifications are given for 75 models, including pressure and vacuum types. Among the special filters developed are units for service at air pressures up to 6000 psi.; others are designed for the removal of carbon black and aluminum oxide from natural gas.

Information on the application of motors for driving all types of large air compressors is given in Issue No.12 of the E-M Synchronizer published by Electric Machinery Manufacturing Company, Minneapolis 13, Minn. The 24-page bulletin contains tables, charts, and graphs to assist in matching motor characteristics to compressor requirements. It also carries a technical discussion of "synchronizing power" and articles on the various methods of controlling compressor motors and means for protecting them against voltage dip and overload.